

NATURAL HISTORY

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Nuclear Slinky

—by—

Jane Connors, waitress

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Ask Jane Connors, waitress in a Greenwich Village restaurant, fumble-fingers with a camera.

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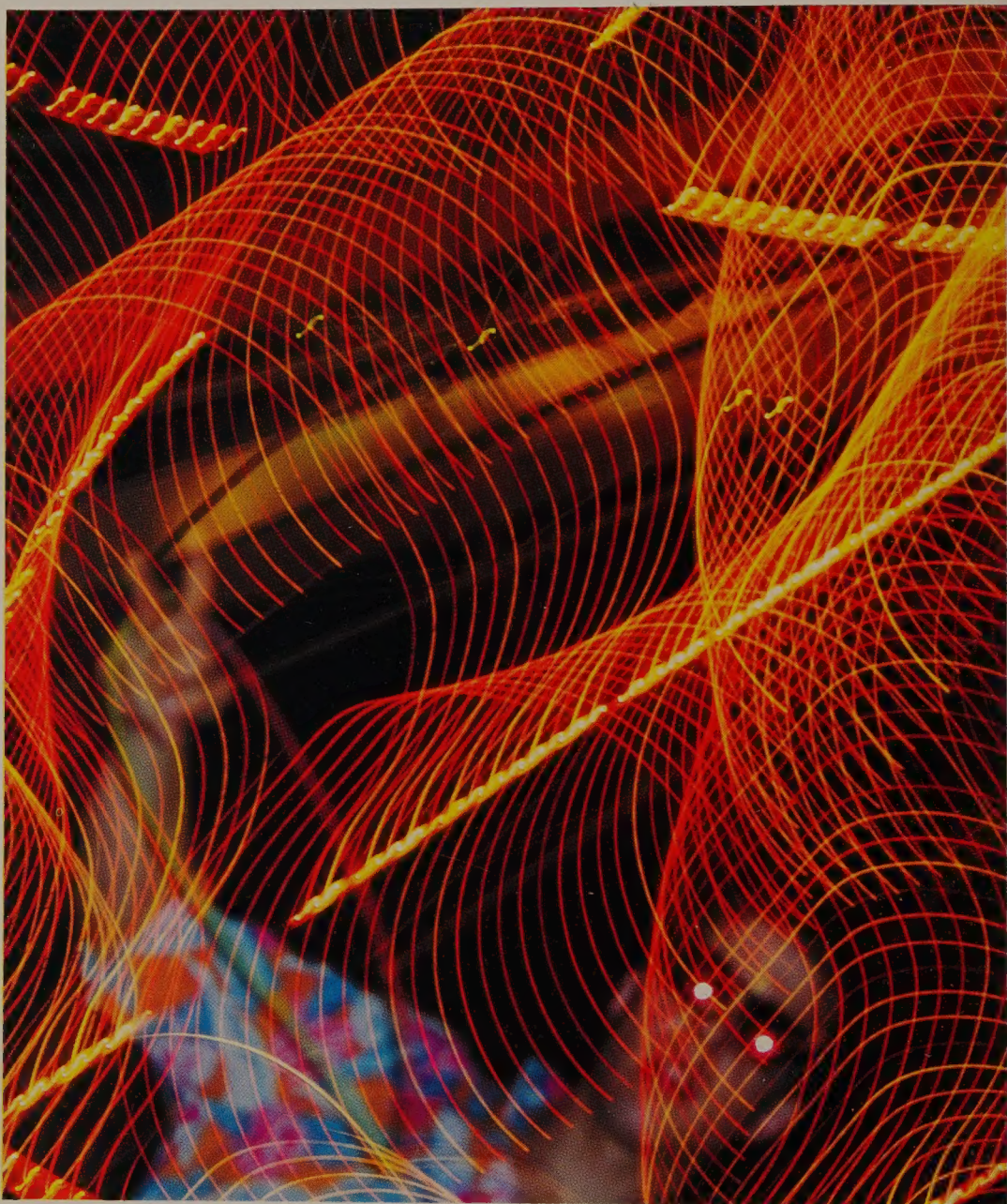
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Jane Connors: waitress by trade, amateur photographer by fun, turned a Ferris wheel into a Slinky with a Nikon N6006. Weird, huh?

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that automatically fires the camera's built-in flash even when you're making a time exposure.

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Jane shot with a 28-70mm autofocus zoom lens. You can choose from nearly twenty interchangeable autofocus Nikkor lenses, the same Nikon lenses used by

Or exactly what the camera's doing. We won't get into semantics.

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NATURAL HISTORY

OCTOBER 1991

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LETTERS

MOSQUITOES: PROS AND CONS

I usually look forward to reading several articles in the magazine, but July's "mosquito" issue held very little of interest for me. Even Gould's column was boring. (The magazine was not a complete waste, however; I rolled it up and swatted several mosquitoes.) What went wrong?

SHANNON D. STONE
Charlottesville, Virginia

Just now, at 2:30 A.M., I finished reading your July issue. When I picked it up and turned first (as I always do) to Stephen Jay Gould's "This View of Life," I thought to read only the one article tonight. Later, as I thought of the astounding and wonderful concept of a shared anatomy between insects and humans, as told by Gould in his always inimitable way, I almost unconsciously turned another page.

Soon I was caught up by the Grantsburg Swamp. And so on through the magazine to the last page, then back to the front to catch the mosquito stories I had missed. It was an exciting experience. This is a particularly memorable edition of *Natural History*.

MRS. MARTIN LOUCKS
Neodesha, Kansas

Regarding Gary Larson's mosquito cartoon: It is not the male that feeds on blood and spreads malaria but the female, a fact that is pointed out several times in your excellent issue.

MARTIN WEISS
New York Hall of Science
Corona, New York

In his 1989 book, *Prehistory of the Far Side*, Gary Larson wrote: "I really heard it when this 'mosquito' cartoon came out. Numerous readers wrote to remind me that the *female* does the biting, not the male. I knew that. (Of course, it's perfectly acceptable that these creatures wear clothes, live in houses, speak English, and so on.)"—Eds.

The mosquito issue really looks beautiful, but a couple of our entomologists were quick to point out that the photograph on

page 5 is not, as the caption suggests, an *Anopheles*—members of that genus have palps as long as their proboscis.

WILLIAM A. HAWLEY
Center for Infectious Diseases
Atlanta, Georgia

GLACIAL CORRECTION

In the May 1991 "This Land" feature, Robert H. Mohlenbrock suggests that Moore's Run, a tributary of Otter Creek, in West Virginia, flows through a bog that "is a legacy of the great continental ice sheet that covered the area about 12,000 years ago and scoured out depressions where water accumulates." Indeed, boreal bogs often develop in glacially eroded depressions; however, this section of the Allegheny Mountains has never been glaciated. The maximum extent of the late Cenozoic glaciations lies approximately 125 miles north of the Otter Creek Wilderness area. Bogs can develop for reasons other than glacial erosion. Nevertheless, the bog most likely does date from the late glacial or early postglacial period.

BRYON MIDDLEKAUFF
Plymouth, New Hampshire


THE HARDEST WHALEBONE

In "Some Vertebrate Ears: In Air and ... in Water" (March 1991), the text states that the auditory bulla is "the hardest material in the cetacean body." As a dentist, I'd been taught that tooth enamel is the hardest substance in animals with teeth.

MICHAEL A. BARON
Branford, Connecticut

Tooth enamel *is* the hardest material in the cetacean body, according to James Mead, curator of marine mammals at the National Museum of Natural History in Washington, D.C.

But scientists look at density as well as hardness when considering the strength of a substance. The auditory bulla, or ear bone, is one of the densest bones in cetaceans, says John Heyning, an assistant curator of mammals at the Natural History Museum of Los Angeles County. In certain beaked whales, however, the rostrum, or snout, is actually denser.—Eds.



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Trickster Treats

What do Bugs Bunny and Brer Rabbit have in common?

by Samuel M. Wilson

In the tall mountains and forests of the Northwest, before the Whites came, and even before the advent of the Real People—the Nee Mee Poo, or Nez Perce—Coyote lived there. The Nez Perce of Idaho and the northern Rockies tell how their very existence is owed to the cleverness of Coyote, the legendary trickster of Native American folk tradition:

Long before there were any people on the earth, a huge monster came down from the North, eating every animal he could find. He ate all the animals, from the smallest to the largest, from mice to mountain lions, all except Coyote, the trickster. Coyote could not find any of his friends, and this made

him mad. So he crossed the Snake River and climbed the highest mountain. He tied himself to its peak with a stout rope and challenged the monster to try to eat him. The monster tried to suck Coyote from his perch, but the rope was too strong. Suspecting that Coyote was more clever than he, the monster befriended Coyote and asked him to come stay with him.

One day Coyote asked the monster if he could go into his stomach and visit all the animals the monster had eaten, and the monster agreed. Once inside, Coyote told his friends to get ready to escape. He took out his fire starter and built a huge fire in the belly of the monster. Then he took his knife and cut out the monster's heart. All the animals escaped.

In honor of the defeat of the monster, Coyote said that he would create a new animal. He cut the monster into pieces and flung them in all directions; where each piece landed—on the plains, along the rivers, and on the mountains of North America—a tribe of Indians sprang up. When he had finished, Coyote's friend Fox observed that no tribe was born on the spot where Coyote had killed the monster. Coyote was sad because of this omission, but he had no more monster parts. Then he had an idea. He washed the monster's blood from his hands and let the drops fall on the ground. Coyote said, "Here on this ground I make the Nez Perce. They will be few in number, but they will be strong and pure." And this is how the human beings came to be. [Retold from "Coyote Makes Human Beings," in *Giving Birth to Thunder, Sleeping with His Daughter*, by Barry Holstun Lopez (Kansas City: Sheed Andrews and McMeel, 1977).]

Trickster tales are the most widespread form of Native American folk tale. The trickster most often is the coyote or rabbit, but sometimes he is a spider, as among the Oglala Dakota. Whatever he is called, his name has only a little to do with his character, which is an amalgam of the characteristics of his animal namesake, humans, and supernatural beings.

The trickster tale is not just a Native American phenomenon: it is found in folklore or mythology throughout the world. In Greek mythology, Prometheus and his

brother Epimetheus possess both the trickster's cunning and his foolishness, as does Hermes. In Polynesia, Maui the trickster makes rope of his sister's hair to lasso and slow down Ra, the sun. The spider Ananse is the trickster among the Ashanti of Africa: an enormous class of their trickster tales is simply called *anansesem*, or "spider stories," regardless of whether Ananse appears in them. Among the Azande people of central Africa the trickster is a spider as well: Ture is an animal so clever he can make a web out of himself. But anthropologist E. E. Evans-Pritchard, in his classic *Zande Trickster*, speaks of the complexities and contradictions in the trickster's character, calling Ture

a monster of depravity: liar, cheat, lecher, murderer; vain greedy, treacherous, ungrateful, a poltroon, a braggart. This utterly selfish person is everything against which Azande warn their children most strongly. Yet he is the hero of their stories, and it is to their children that his exploits are related and he is presented, with very little moralizing—if as a rogue, as an engaging one. For there is another side to his character, which even to us is appealing: his whimsical fooling, recklessness, impetuosity, puckish irresponsibility, his childish desire to show how clever he is . . . and his flouting of every convention. In spite of his nefarious conduct he is never really malicious. Indeed he has an endearing innocence.

Like most myths and folk tales, the trickster tales encode varying values and ideas, and some of these are specific to particular cultures. Yet the same themes are played out in strikingly similar ways throughout the world because the trickster tales deal with issues of universal human experience—family interactions, competition, struggles against authority, love, and death. The many sides to the trickster's personality make him especially useful to the storyteller: some tales emphasize the trickster's spiritual side and others his material side; some his role as creator and some as mean-spirited de-

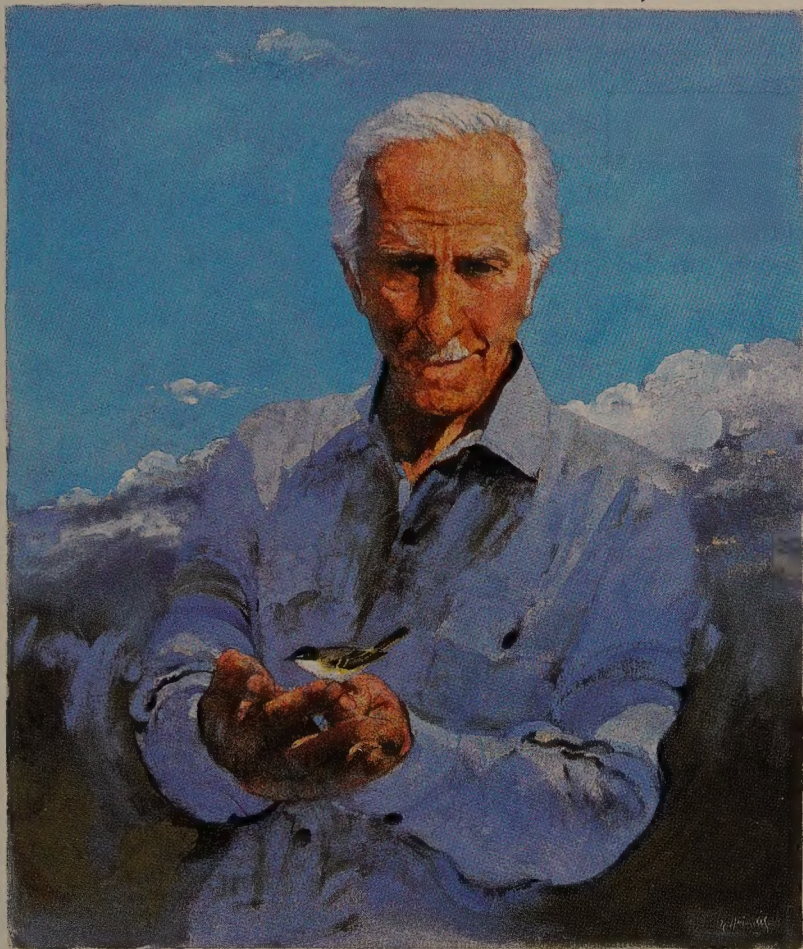


Puck mocks humanity in Shakespeare's A Midsummer Night's Dream.

Arthur Rackham; Folger Shakespeare Library

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stroyer. The psychologist Carl Jung saw in the trickster a primordial figure who transcends humankind's conceptual boundaries between gods and mortals; who moves freely between the worlds of gods and humans and plays tricks on both.

Many stories capture the trickster as the primal comedian, able to step outside of a situation (or a culture) and point out its ridiculousness. The trickster is incarnated in Shakespeare's Puck of *A Midsummer Night's Dream* and in cartoons ("Twicky wabbit" is what Elmer Fudd calls Bugs Bunny, a classic trickster if ever there was one). Bart Simpson's constant challenge to authority qualifies him for the trickster role.

Trickster tales often serve to entertain and instruct children, teaching them how to behave and how the world works. In Native American stories, as elsewhere, the trickster is often the underdog, never the most powerful or beautiful animal. The trickster is the one who through cleverness defeats more powerful forces, using their very superiority, arrogance, or vanity as a weapon against them. The story of Possum's tail warns against such hubris, as in this version, which combines elements of similar stories told throughout eastern North America:

Possum was proud of his long, bushy tail; he took great pleasure in combing it out every day, and especially in waving it in front of Coyote (whose own tail was scraggly and flea-bitten). When the Animal People came together for council and a big dance, Possum demanded a special seat so that everyone could see his beautiful tail. Coyote agreed to this, and told Possum that he would even send Cricket over to comb out his tail before the dance.

Before sending him to help Possum primp, Coyote had a talk with Cricket (who was the best barber among the Animal People). Cricket went and spent hours brushing out Possum's tail, and when he was done he carefully wrapped the tail in a red thread and said, "Possum, this string will keep all the hairs in place until the dance. When you get to the council and it's time to dance then you can take the string off."

Possum went to the lodge where the dance was held and took his place of honor in the middle of the Animal People. When the drummers began, Possum removed the thread and began to dance in the middle of the lodge. "See my beautiful tail," he said, as everyone began to snicker. He said, "See how fine the fur is," while Coyote nearly wept trying to contain himself. "See how it sweeps the ground," he said, as all the Animal People roared in laughter. Finally Possum looked around at his naked, scaly tail. He rolled onto his back and grinned, as he does to this day when he's caught by surprise.

While trickster tales may warn against vanity, greed, and excessive cleverness,

they are also highly entertaining, which helps to account for their wide distribution and longevity. The similarities in trickster stories drawn from African American and Native American folk tales are apparent in the following examples. The first features one of the most famous tricksters known to contemporary Americans—Brer Rabbit, whose roots lie in West African folk tale traditions. In "How Brother Fox Was Too Smart," as in many trickster tales, Brer Rabbit uses Fox's conceit to bring him down:

Walking with Fox one day, they saw a track that Brer Fox did not recognize. When Fox asked what it was, Rabbit said, "If I'm not mistaken, the poor creature who made that track is Cousin Wildcat, no more and no less." "How big is he, Brer Rabbit," Fox asked. "He's about your size." Then Brer Rabbit acted like he was talking to himself, "Tut, tut, tut! It's funny that I should come across Cousin Wildcat in this part of the world. Many's the time I saw my Granddaddy kick and cuff Cousin Wildcat, so much so that I felt sorry for him. If you want any fun, Brer Fox, now's the time to get it." Brer Fox, who fancied himself a fighter, was interested; he asked Brer Rabbit how he was going to have fun with the Wildcat. "It's easy enough. Just go tackle ole Cousin Wildcat and slam him around. . . . Just hit him a good one, and if he tries to run away, I'll catch him for you."

The climax of the story is predictable enough, with Rabbit coaxing Fox into an unwise battle:

In short order, Fox was lying on the ground in pieces crying, "I'm ruined, Brer Rabbit! I'm ruined! Run get the doctor, I'm totally ruined!" Brer Rabbit headed home and when he got out of sight, he bent over and



Once again, fast-thinking Brer Rabbit
outsmarts big Brer B'ar.

Arthur Burdette Frost; Houghton Mifflin Company

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Mr.

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follows a long
tradition.*

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shook his hands like a cat does when she gets water on her feet, and he laughed and laughed until he was nearly sick from laughing. [Retold from *Nights with Uncle Remus*, by Joel Chandler Harris, 1881.]

In a similar confrontation, the two great tricksters of North America—Coyote and Rabbit—attempt to outsmart each other:

One day Coyote came upon Rabbit, who was making a strong leather sack. He asked, "What is that sack for, Rabbit?" Rabbit replied, "A hailstorm is coming, and I'm making this sack to protect myself." "Rabbit," said Coyote, "give me this sack and make yourself another one, so that we can both be safe." Coyote climbed into the sack and Rabbit hung him in a tree. Making sounds like a violent storm, Rabbit pelted the sack with rocks. When Coyote stuck his head out and saw that the hailstorm was only Rabbit throwing rocks, he was very angry. He chased Rabbit, who had gone to a field where crops were growing. Rabbit's curiosity was aroused by a stick figure in the field covered with sticky gum. When Rabbit touched it, his finger became stuck, and the more he tried to work himself free, the more stuck he became. Finally Coyote arrived, still angry. "Rabbit, before I kill you, tell me what you are doing stuck to that pole." Thinking fast, Rabbit replied, "The person whose crops these are wants me to share a feast with him, but I don't want to do it. He says that after I've been stuck to this pole for a while, I'll be hungry enough to share his great meal." So Coyote pulled Rabbit loose and stuck himself to the pole. When the angry farmer returned, Coyote paid the price.

Now Coyote was so angry he was biting his tongue and walking into rocks. When he found Rabbit again he said, "Now I am going to kill you before you can say another word." Rabbit was sitting in front of a beehive, and he gestured for Coyote to be quiet. "Be quiet, Coyote, I am teaching

these small children, and afterwards they will repay me with a meal." Coyote couldn't see into the hive, and did not recognize it for what it was. But he thought that he could finally outsmart Rabbit. "Let me teach the children for a while, Rabbit, while you rest. By the way, how will they know when it is time to serve up your meal?" Rabbit replied, "When it is dinner time you must hit the hive with this club until they come out. You must hit it very hard, because they do not hear very well." Coyote lectured to the humming hive for a long while. He told of what a great warrior he was and of the great battles he had fought. Finally he began to get hungry. He looked around to make sure that Rabbit was out of sight, and then took the club and hit the hive so hard that it broke in two.

In these two tales both Rabbit and Coyote (or Fox) are tricksters, and in turn they show their mixture of artful finesse and bumbling stupidity. They beat their heads together and produce entertaining stories that have been successful for ages. But in doing so they transmit basic truths about the human condition.

In the Winnebago stories of the trickster called Hare, the ambiguous hero decides to help out the human beings and makes all the animals defenseless against them. But when he returns to the lodge of his grandmother (who in this cycle of stories represents the earth herself), he finds that although he has cleverly achieved what he wanted, outsmarting each of the animals in turn, the result does more harm than good:

Hare thought to himself, "Now the people will live peacefully and forever." But the old woman, his grandmother, said, "Grandson, your talk makes me sad. How can the people live forever, as you do? Earthmaker did not make them thus. All things have to have an end. You yourself in your travels around the country must have seen trees fallen to the ground. That is their end; that is their death. Everything will have an end. I also will have an end as I am created that way." Then Hare looked in her direction and some of her back caved in just as the earth does sometimes. That was what he saw. And he saw people cave in with the earth. "Grandson, thus it is," said the old woman, "I have been created small and if all the people live forever they would soon fill up the earth. There would then be more suffering than there is now, for some people would always be in want of food if they multiplied greatly. That is why everything has an end." Then Hare thought for a long time. "A good thing I had obtained for the people, but my grandmother has spoiled it." So he felt sad, took his blanket, covered himself with it, lay down in the corner and wept. [Retold from the Winnebago Hare cycle in *The Trickster*, by Paul Radin (London: Routledge & Kegan Paul, 1956).]

Samuel M. Wilson teaches anthropology at the University of Texas.

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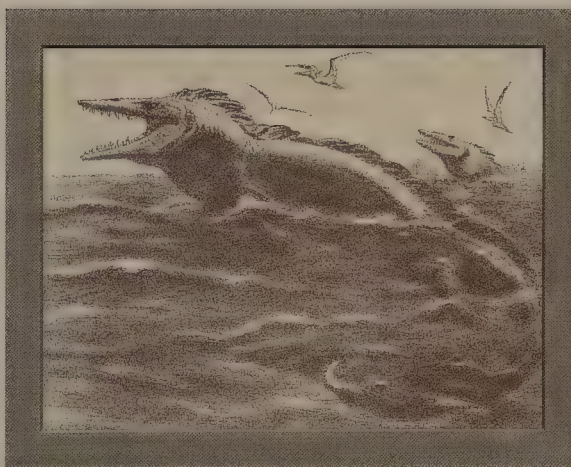
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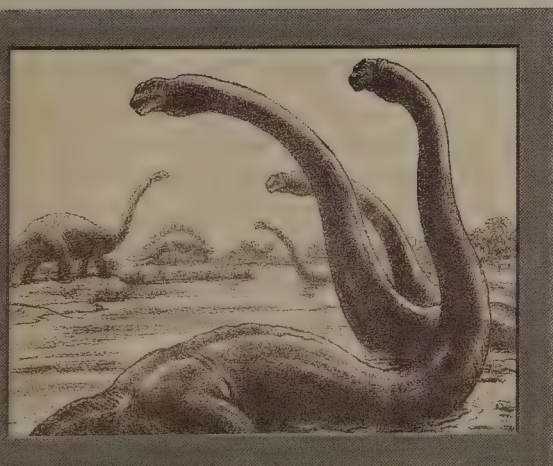
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Brandon Bleck, Pirate

Only the real crooks don't need Halloween

by Roger L. Welsch

It's October, and the only anonymous Americans left are street crooks. In fact, I think street crooks are street crooks because they have figured out how to be anonymous. I live in Dannebrog, Nebraska, population 320, and I can't get away with anything because everyone knows me. Everyone in town recognizes my car, my children, even my dog. In Baltimore, I could get away with almost anything because no one in Baltimore knows me, but in Dannebrog? Nothing. Here I'm accused of doing things I can't do. It's like that in a small town.

I have no reason to be anonymous (I am not a crook), but now and then anonymity would be convenient, even comforting. But these days there isn't an option. I make a business call, and the lady answering the telephone says, "Yes, Miz Toory is in. May I tell her who is calling?"

Whom is she trying to kid? We know this strategy. The translation reads, "Miz Toory wants to know if you are someone she should bother with." I'd rather be anonymous in this situation, so I sometimes say, "Just tell her it's the IRS." Or "I'm calling from the White House." Or "It's the IRS, calling from the White House."

At meetings I attend these days—luncheons, conventions, cocktail gatherings, funerals—right inside the door is a table where someone with a felt pen makes a name tag on which they spell my name wrong: "Hi! I'm ROGUER WELCSH and I'm from DANNENBERG! Have a nice day!" The misspellings are a pleasant point of departure for conversation, but again, I would just as soon make my own introductions. Or remain anonymous. On all my sports coats, the left lapel is worn thin where I have peeled off thousands of name tags.

Even worse was the time last month when I went just a touch over the speed limit and a state trooper asked to see my license. He looked at it, and just when I expected him to address me as "Roger,"

he called me "Mario Andretti." I would have preferred anonymity that time too.

I looked at his name on the badge on his chest and for a moment considered calling him "Clarence" or, maybe more humorously, "The Tetminator," but with what I now recognize as well-advised moderation, I addressed him instead as "Yes, Mister Officer Adams, sir."

And how about all these warnings the government now requires on a wide range of products? (I know this doesn't have anything to do with anonymity, but I'm getting to the point, no kidding.) Have you looked at new ladders recently? They are plastered with warning tags: "Don't stand above this step," "Don't use this ladder if you weigh more than 150 pounds (!)," "Make sure this ladder is sitting on concrete at least three inches thick and absolutely level," "Think about using something other than this ladder," that sort of thing. Edmund Hillary and Tenzing Norgay faced fewer threats when they climbed Everest.

So what does all this have to do with October? Halloween, that's what. Specifically, little kids and Halloween.

Remember what life was like when you were a child? Everyone in the neighborhood knew every kid by name, reputation, and parentage. Talk about a loss of anonymity! I once had a study in an upstairs room of a suburban house; my window looked out over a yard and trees and an alley. I was working one day when I saw Brandon Bleck, a run-of-the-mill kid, strolling along the alley. He was carrying a stick, and as he walked along, he banged on fences, doing what he could to rile the dogs. Dogs barked and growled up the alley a block or so behind Brandon, and dogs were arrayed at backyard gates a couple of hundred feet in front of him, waiting to be riled. I quietly opened my study window and yelled out, "Hey, Brandon! You cut that out right now or I'm going to tell your dad!"

My wife says my voice is in the same

class as that of whoever it is who plays God in Charlton Heston movies, so I anticipated that Brandon would stop dead in his tracks, look around him in terror for the source of the disembodied voice, maybe yell something like "I'm sorry, I'm really sorry!" and then run down the alley, chastened and improved by my instructions. Like Charlton Heston.

But Brandon didn't even look up. He moved down the alley a little quicker—but not a lot—to the next block, from where I soon again heard the rattle of his stick against fences and the warm response of dogs. Brandon expected to be caught. As a little kid, he assumed that a dark voice would thunder at him from the sky, would know his name, would disprove of what generations of children in alleys (including me) had done before him, and would threaten to rat on him. That's what life is like for a little kid.

When you're a little kid, everyone is bigger than you—and always will be. You will never ever be bigger than your mean big brother Eddie. When you're eighty years old, he'll be eighty-three, probably still bigger, and by every indication, still mean. As a child, you never get to do anything, and explanations for all the restrictions are hopelessly arcane.

"Be careful or you'll poke out Eddie's eye," for example. Good grief, that's precisely what you had in mind! Adults argue about health warnings now required on beer cans, cigarette packages, and cauliflower. When you're a little kid, everything carries dire threats: "Eat your boiled carrots or you'll get no dessert," the Big Guys say. Unless you like carrots. Then they say, "Don't eat too many boiled carrots or there'll be no dessert."

A child's life is one of crushing oppression, and the more your parents love you, the worse the oppression. Take it from me. My parents loved me. My childhood was hell. I never got to do anything.

Scientific folklorists say that the more oppressed a society is, the more it needs a

"safety valve," an approved time, place, and process through which pressures can be relieved; an opportunity to loosen—briefly—the restrictive bonds that hold sway the rest of the year.

For kids, that's Halloween.

This is the one day of the year Brandon Bleck or his brother Justin or maybe by now his son Jason can be anonymous. He gets to put on weird clothes, conceal his identity behind a mask, threaten grown-ups, stay out after dark, demand candy, eat too much, and invade alien porches. If Brandon's parents are typical, they'll try to talk him out of weird clothes and a mask, dab some yellow paint on his face, mousse his hair, and tell him he's Bart Simpson. They'll take him to his grandmother's house at four in the afternoon and explain that it's dangerous to be out after dark. They'll warn him that if he eats too much, he'll throw up.

Of course he'll throw up! That's the point—eating too much and throwing up. (Remember how you felt last year the day after Saint Patrick's Day?)

Yes, I know: Halloween used to be a religious holiday, and it smacks of voodoo and witchcraft, black magic and Satanism, necrophilia and sugar frenzies. Forget all that. Halloween is the one last chance we have to defuse the most volatile, righteously indignant minority we have—our children.

Come October 31, if he's still making the rounds, I'll recognize the Bleck kid when he shows up at my door. (I know my dog will.) But I'll pretend he really is a pirate. I hope his father lets him stay out until his sack is full, and that he gets lots of chocolate bars and only a couple of apples. I hope he eats it all that night and throws up. I hope he soaps one of Old Man Taylor's windows. It's all Brandon Bleck has—this one night out of 365. And it's not much to ask.

Folklorist Roger L. Welsch lives in Dannebrog, Nebraska.

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The Moral State of Tahiti— and of Darwin

How do we judge the racial attitudes of an eminent Victorian?

by Stephen Jay Gould

I don't want to float a sour note during our worldwide Mozartian orgy for the bicentennial of his death (December 5, 1791), but let's face it, the compositions he wrote at age four and five are not enduring masterpieces, however sweet. We even have a word—*juvenilia*—for such "literary or artistic works produced in the author's youth" (*Oxford English Dictionary*). The term has always borne a derogatory tinge; artists certainly hope for substantial ontogenetic improvement! John Donne, in the second recorded use of the word (1633), entitled his early works: "Iuuenilia: or certaine paradoxes and problemes."

I shouldn't place myself in such august company, but I do feel the need to confess. My first work was a poem about dinosaurs, written at age eight. I cringe to remember its first verse:

Once there was a *Triceratops*
With his horns he gave big bops
He gave them to an allosaur
Who went away without a roar.

(I cringe even more to recall its eventual disposition. I sent the poem to my boyhood hero, Ned Colbert, curator of dinosaurs at the American Museum of Natural History. Fifteen years later, when I was taking his course as a graduate student, Colbert happened to clean out his old files, found the poem, and gleefully shared it with all my classmates one afternoon.)

Now, a trivia question on the same theme: what was Charles Darwin's first published work? A speculation on evolution? Perhaps a narrative of scientific discovery on the *Beagle*? No, this greatest and most revolutionary of all biologists, this inverter of the established order, published his first work in the *South African Christian Recorder* for 1836—a joint article with *Beagle* skipper Robert FitzRoy on "The Moral State of Tahiti." (The

standard catalog of Darwin's publications lists one prior item—a booklet of *Beagle* letters addressed to Professor Henslow and printed by the Cambridge Philosophical Society in 1835. But this pamphlet was issued only for private distribution among members—the equivalent of an informal modern photocopying. "The Moral State of Tahiti" represents Darwin's first public appearance in print, and biographers record it as his first publication—even though the article is mostly FitzRoy's, with long excerpts from Darwin's diaries patched in and properly acknowledged.)

The great Russian explorer Otto von Kotzebue had poured fuel on an old and worldwide dispute by arguing that Christian missionaries had perpetrated far more harm than good in destroying native cultures (and often cynically fronting for colonial power) under the guise of "improvement." FitzRoy and Darwin wrote their article to attack Kotzebue and to defend the good work of English missionaries in Tahiti and New Zealand.

The two shipmates began by noting with sorrow the strong antimissionary sentiments that they had encountered when the *Beagle* called at Capetown:

A very short stay at the Cape of Good Hope is sufficient to convince even a passing stranger, that a strong feeling against the Missionaries in South Africa is there very prevalent. From what cause a feeling so much to be lamented has arisen, is probably well known to residents at the Cape. We can only notice the fact: and feel sorrow.

Following a general defense of missionary activity, FitzRoy and Darwin move to specific cases of their own prior observation, particularly to the improved "moral state" of Tahiti:

Quitting opinions . . . it may be desirable to see what has been doing at Otaheite (now called Tahiti) and at New Zealand, towards reclaiming the "barbarians." . . . The *Bea-*

gle passed a part of last November at Otaheite or Tahiti. A more orderly, quiet, inoffensive community I have not seen in any other part of the world. Every one of the Tahitians appeared anxious to oblige, and naturally good tempered and cheerful. They showed great respect for, and a thorough good will towards, the missionaries; . . . and most deserving of such a feeling did those persons appear to be.

FitzRoy and Darwin were, obviously, attentive to a possible counterargument—that the Tahitians have always been so decent, and that missionary activity had been irrelevant to their good qualities by European taste. The article is largely an argument against this interpretation and a defense for direct and substantial "improvement" by missionaries. Darwin, in particular, presents two arguments, both quoted directly from his journals. First, Tahitian Christianity seems deep and genuine, not "for show" and only in the presence of missionaries. Darwin cites an incident from his travels with native Tahitians into the island's interior, far from scrutiny. (This incident must have impressed Darwin powerfully, for he recited it in several letters to family members and included an account in his *Voyage of the Beagle*):

Before we laid ourselves down to sleep, the elder Tahitian fell on his knees, and repeated a long prayer. He seemed to pray as a christian should, with fitting reverence to his God, without ostentatious piety, or fear of ridicule. At daylight, after their morning prayer, my companions prepared an excellent breakfast of bananas and fish. Neither of them would taste food without saying a short grace. Those travellers, who hint that a Tahitian prays only when the eyes of the missionaries are fixed on him, might have profited by similar evidence.

Second, and more important, Tahitian good qualities were directly created or substantially fostered by missionary activity. They were a dubious lot, Darwin as-

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serts, before Western civilization arrived.

On the whole, it is my opinion that the state of morality and religion in Tahiti is highly creditable. . . . Human sacrifices,—the bloodiest of warfare,—parricide,—and infanticide,—the power of an idolatrous priesthood,—and a system of profligacy unparalleled in the annals of the world,—have been abolished,—and dishonesty, licentiousness, and intemperance have been greatly reduced, by the introduction of Christianity.

(On the subject of sexual freedom in women, so long an issue and legend for all Tahitian travelers from Captain Cook to Fletcher Christian, FitzRoy remarked: "I would scarcely venture to give a general opinion, after only so short an acquaintance; but I may say that I witnessed no improprieties." Nonetheless, FitzRoy did admit that "human nature in Tahiti cannot be supposed superior to erring human nature in other parts of the world." Darwin then added a very keen observation on hypocrisy in Western male travelers who do not sufficiently credit missionaries as a result of their private frustration on this issue: "I do believe that, disappointed in not finding the field of licentiousness so open as formerly, and as was expected, they will not give credit to a morality which they do not wish to practise.")

Many arguments float back and forth throughout this interesting article, but the dominant theme can surely be summarized in a single word: paternalism. We know what is good for the primitives—and thank God they are responding and improving on Tahiti by becoming more European in their customs and actions. Praise the missionaries for this exemplary work. One comment, again by FitzRoy, captures this theme with special discomfort (to modern eyes) for its patronizing approach, even to royalty:

The Queen, and a large party, passed some hours on board the *Beagle*. Their behavior was extremely correct, and their manners were inoffensive. Judging from former accounts, and what we witnessed, I should think that they are improving yearly.

Thus, we may return to my opening issue—the theme of juvenilia. Shall we rank "The Moral State of Tahiti," Darwin's very first article, in the category of severe later embarrassments? Did Darwin greatly revise his views on non-Western peoples and civilizations and come to regard his early paternalism as a folly of youthful inexperience? Much traditional commentary in the hagiographical mode would so have it, and isolated quotations can be cited from here and there to support such an interpretation (for Darwin was a complex man who wrestled with

deep issues, sometimes in contradictory ways, throughout his life).

But I would advance the opposite claim as a generality. I don't think Darwin ever substantially revised his anthropological views. His basic attitude remained: "They" are inferior but redeemable. His mode of argument changed in later life. He would no longer have framed his opinions in terms of traditional Christianity and missionary work. He would have tempered his strongest paternalistic enthusiasm with a growing understanding (cynicism would be too strong a word) of the foibles of *human* nature in all cultures, including his own. (We see the first fruits of such wisdom in his comment, cited previously, on why sexually frustrated travelers fail to credit the Tahitian missionaries.) But his basic belief in a hierarchy of cultural advance, with white Europeans on top and natives of different colors on the bottom, did not change.

Turning to the major work of his maturity, *The Descent of Man* (1871), Darwin writes in summary:

The races differ also in constitution, in acclimatisation, and in liability to certain diseases. Their mental characteristics are likewise very distinct; chiefly as it would appear in their emotional, but partly in their intellectual faculties. Every one who has had the opportunity of comparison, must have been struck with the contrast between the taciturn, even morose, aborigines of S. America and the lighthearted, talkative negroes.

The most striking passage occurs in a different context. Darwin is arguing that discontinuities in nature do not speak against evolution, because most intermediate forms are now extinct. Just think, he tells us, how much greater the gap between apes and humans will become when both the highest apes and the lowest people are exterminated:

At some future period, not very distant as measured by centuries, the civilized races of man will almost certainly exterminate and replace throughout the world the savage races. At the same time the anthropomorphous apes . . . will no doubt be exterminated. The break will then be rendered wider, for it will intervene between man in a more civilized state, as we may hope, than the Caucasian, and some ape as low as a baboon, instead of as at present between the negro or Australian and the gorilla.

The common (and false) impression of Darwin's egalitarianism arises largely from selective quotation. Darwin was strongly attracted to certain peoples often despised by Europeans, and some later writers have falsely extrapolated to a presumed general attitude. On the *Beagle*

voyage, for example, he commented about African blacks enslaved in Brazil:

It is impossible to see a negro and not feel kindly towards him; such cheerful, open, honest expressions and such fine muscular bodies; I never saw any of the diminutive Portuguese with their murderous countenances, without almost wishing for Brazil to follow the example of Hayti.

But toward other peoples, particularly the Fuegians of southernmost South America, Darwin felt contempt: "I believe if the world was searched, no lower grade of man could be found."

Elaborating later in his voyage, Darwin writes:

Their red skins filthy and greasy, their hair entangled, their voices discordant, their gesticulation violent and without dignity. Viewing such men, one can hardly make oneself believe that they are fellow creatures placed in the same world. . . . It is a common subject of conjecture, what pleasure in life some of the less gifted animals can enjoy? How much more reasonably it may be asked with respect to these men.

On the subject of sexual differences, so often a surrogate for racial attitudes, Darwin writes in *The Descent of Man* (and with direct analogy to cultural variation):

It is generally admitted that with woman the powers of intuition, of rapid perception, and perhaps of imitation, are more strongly marked than in man; but some, at least, of these faculties are characteristic of the lower races, and therefore of a past and lower state of civilization. The chief distinction in the intellectual powers of the two sexes is shown by man attaining to a higher eminence, in whatever he takes up, than woman can attain—whether requiring deep thought, reason, or imagination, or merely the use of the senses and hands.

Darwin attributes these differences to the evolutionary struggle that males must pursue for success in mating: "These various faculties will thus have been continually put to the test, and selected during manhood." In a remarkable passage, he then expresses thanks that evolutionary innovations of either sex tend to pass, by inheritance, to both sexes, lest the disparity between men and women grow ever greater by virtue of exclusively male accomplishment:

It is, indeed, fortunate that the law of the equal transmission of characters to both sexes has commonly prevailed throughout the whole class of mammals; otherwise it is probable that man would have become as superior in mental endowment to woman, as the peacock is in ornamental plumage to the peahen.

Shall we then simply label Darwin as a racist and sexist all the way from youthful folly to mature reflection? Such a stiff-

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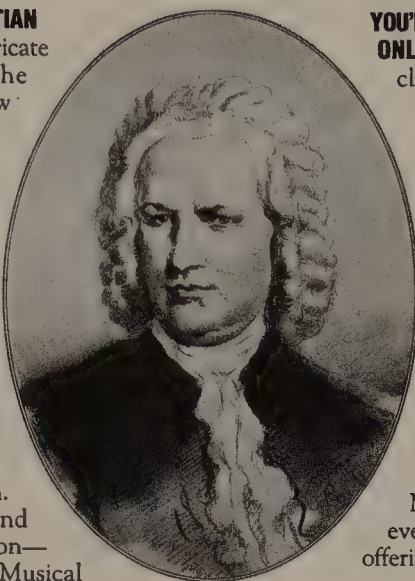
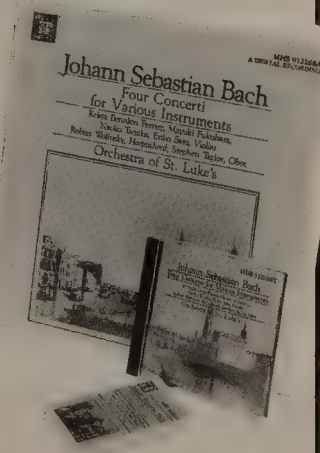
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necked and uncharitable attitude will get us nowhere if we wish to understand and seek enlightenment from our past. Instead, I will plead for Darwin on two grounds: one general; the other personal.

The general argument is obvious and easy to make. How can we castigate someone for reflecting a standard attitude of his age, however much we may legitimately deplore that attitude today? Belief in racial and sexual inequality was unquestioned among upper-class Victorian males—probably about as controversial as the Pythagorean theorem. Darwin did construct a different rationale for a shared certainty, and for this we may exact some judgment. But I see no purpose in strong criticism for a largely passive acceptance of common wisdom. Let us rather analyze why such potent and evil nonsense then passed for certain knowledge.

If I choose to impose individual blame for all past social ills, there will be no one left to like in some of the most fascinating periods of our history. For example, if I place every Victorian anti-Semite beyond the pale of my attention, my compass of available music and literature will be pitifully small. Although I hold no shred of sympathy for active persecutors, I cannot excoriate individuals who acquiesced passively in a standard societal judgment. Rail instead against the judgment and try to understand what motivates men of decent will.

The personal argument is more difficult and requires substantial biographical knowledge. Attitudes are one thing, actions another—and by their fruits ye shall know them. What did Darwin do with his racial attitudes, and how do his actions stack up against the moves of his contemporaries? By this proper criterion, Darwin merits our high admiration.

Darwin was a meliorist in the paternalistic tradition, not a believer in biologically fixed and ineradicable inequality. Either attitude can lead to ugly statements about despised peoples, but practical consequences are so different. The meliorist may wish to eliminate cultural practices and may be vicious and uncompromising in his lack of sympathy for differences, but he does view “savages” (Darwin’s word) as “primitive” by social circumstances and biologically capable of improvement (read Westernization). But the determinist regards “primitive” culture as a reflection of unalterable biological inferiority—and what social policy must then follow in an era of colonial expansion: elimination, slavery, permanent domination?

Even for his most despised Fuegians, Darwin understood the small intrinsic dif-

ference between them in their nakedness and him in his regalia. He attributed their limits to a harsh surrounding climate and hoped, in his usual paternalistic way, for their eventual improvement. He wrote in his *Beagle* diary for February 24, 1834:

Their country is a broken mass of wild rocks, lofty hills and useless forests, and these are viewed through mists and endless storms. . . . How little can the higher powers of the mind come into play: what is there for imagination to paint, for reason to compare, for judgment to decide upon? To knock a limpet from the rock does not even require cunning, that lowest power of the mind. . . . Although essentially the same creature, how little must the mind of one of these beings resemble that of an educated man. What a scale of improvement is comprehended between the faculties of a Fuegian savage and a Sir Isaac Newton!

Darwin’s final line on the Fuegians (in the *Voyage of the Beagle*) uses an interesting and revealing phrase in summary: “I believe, in this extreme part of South America, man exists in a lower state of improvement than in any other part of the world.” You may cringe at the paternalism, but “lower state of improvement” does at least stake a claim for potential brotherhood. And Darwin did recognize the beam in his own shipmates’ eyes in writing of their own irrationalisms:

Each [Fuegian] family or tribe has a wizard or conjuring doctor. . . . [Yet] I do not think that our Fuegians were much more superstitious than some of the sailors; for an old quartermaster firmly believed that the successive heavy gales, which we encountered off Cape Horn, were caused by our having the Fuegians on board.

I must note a precious irony and briefly summarize a bizarre and wonderful story. Were it not for paternalism, the *Beagle* might never have sailed, and Darwin would probably have lost his date with history. Regret paternalism, laugh at it, cringe mightily, but grant its most salutary, if indirect, benefit for Darwin. Captain FitzRoy had made a previous voyage to Tierra del Fuego. There he “acquired,” through ransom and purchase, four Fuegians. He then brought them to England for a harebrained experiment in the “improvement” of “savages.” They arrived in October 1830 and remained until the *Beagle* set sail again in December 1831.

One of the four soon died of smallpox, but the others lived at Walthamstow and received instruction in English manners, language, and religion. They attracted widespread attention, including an official summons for a visit with King William IV. FitzRoy, fiercely committed to his paternalistic experiment, planned the next *Beagle* voyage primarily to return the

three Fuegians, along with an English missionary and a large cargo of totally incongruous and useless goods (including tea trays and sets of fine china) donated, with the world’s best will and deepest naïveté, by women of the parish. There FitzRoy planned to establish a mission to begin the great task of improvement for the earth’s most lowly creatures.

FitzRoy would have chartered a boat at his own expense to return York Minster, Jemmy Button, and Fuegia Basket to their homes. But the Admiralty, pressured by FitzRoy’s powerful relatives, finally outfitted the *Beagle* and sent FitzRoy forth again, this time accompanied by Darwin. Darwin liked the Fuegians, and his long contact in close quarters helped to convince him that all people share a common biology, whatever their cultural disparity. Late in life, he recalled (in *The Descent of Man*, 1871):

The American aborigines, Negroes and Europeans differ as much from each other in mind as any three races that can be named; yet I was incessantly struck, whilst living with the Fuegians on board the “*Beagle*,” with the many little traits of character, showing how similar their minds were to ours.

FitzRoy’s noble experiment ended in predictable disaster. They docked near Jemmy Button’s home, built huts for a mission station, planted European vegetables, and landed Mr. Matthews, avatar of Christ among the heathen, along with the three Fuegians. Matthews lasted about two weeks. His china smashed, his vegetables trampled, FitzRoy ordered him back to the *Beagle* and eventually left him in New Zealand with his missionary brother.

FitzRoy returned a year and a month later. He met Jemmy Button, who told him that York and Fuegia had robbed him of all his clothes and tools and left by canoe for their own nearby region. Jemmy, meanwhile, had “reverted” completely to his former mode of life, although he remembered some English, expressed much gratitude to FitzRoy, and asked the captain to take some presents to his special friends—“a bow and quiver full of arrows to the schoolmaster of Walthamstow . . . and two spear-heads made expressly for Mr. Darwin.” In a remarkable example of stiff upper lip in the face of adversity, FitzRoy put the best possible spin upon a personal disaster. He wrote:

Perhaps a ship-wrecked seaman may hereafter receive help and kind treatment from Jemmy Button’s children; prompted, as they can hardly fail to be, by the traditions they will have heard of men of other lands; and by an idea, however faint, of their duty to God as well as their neighbor.

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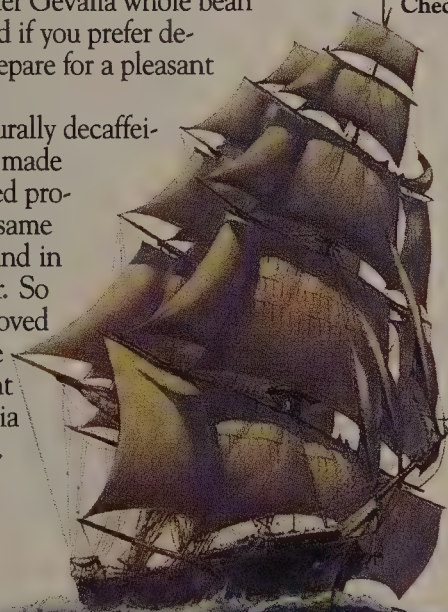
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But the strongest argument for admiring Darwin lies not in the relatively beneficent character of his belief, but in his chosen form of action upon these convictions. We cannot use a modern political classification (Bork versus Marshall on affirmative action) as termini of an old spectrum. Thurgood Marshall's perspective did not exist for the policy makers of Darwin's day. All were racists by our present-day standards. On that spectrum, those whom we now judge most harshly urged that inferiority be used as an excuse for dispossession and slavery, while those whom we most admire in retrospect urged a moral principle of equal rights and nonexploitation, whatever the biological status of people.

Darwin held this second, most admirable position with the two Americans best regarded by later history: Thomas Jefferson and Darwin's soul mate (for they share the same birth date) Abraham Lincoln. Jefferson, although expressing himself tentatively, wrote: "I advance it, therefore, as a suspicion only, that the blacks . . . are inferior to the whites in the endowment both of body and of mind." But he wished no policy of forced social inequality to flow from this suspicion: "Whatever be their degree of talents, it is no measure of their rights." As for Lincoln, many sources have collected his chilling (and frequent) statements about black inferiority. Yet, he is national hero *número uno* for his separation of biological assessment from judgments about moral issues and social policies.

Darwin, too, was a fervent and active abolitionist. Some of the most moving passages ever written against the slave trade occur in the last chapter of the *Voyage of the Beagle*. Darwin's ship, after calling at Tahiti, New Zealand, Australia, and South Africa (where FitzRoy and Darwin submitted their bit of juvenilia to a local paper), stopped for a last visit in Brazil, before setting a straight course to England. Darwin wrote:

On the 19th of August we finally left the shores of Brazil. I thank God I shall never again visit a slave country. . . . Near Rio de Janeiro I lived opposite to an old lady, who kept screws to crush the fingers of her female slaves. I have stayed in a house where a young household mulatto, daily and hourly, was reviled, beaten, and persecuted enough to break the spirit of the lowest animal. I have seen a little boy, six or seven years old, struck thrice with a horse-whip (before I could interfere) on his naked head, for having handed me a glass of water not quite clean. . . . I was present when a kind-hearted man was on the point of separating forever the men, women, and little children of a large number of families who had long lived together.

Darwin then moves from description to refutation and plea for action:

I will not even allude to the many heart-sickening atrocities which I authentically heard of;—nor would I have mentioned the above revolting details, had I not met with several people so blinded by the constitutional gaiety of the negro as to speak of slavery as a tolerable evil.

Refuting the standard argument for benevolent treatment with a telling analogy from his own land, Darwin continues:

It is argued that self-interest will prevent excessive cruelty; as if self-interest protected our domestic animals, which are far less likely than degraded slaves to stir up the rage of their savage masters.

Although I have reviewed them a hundred times, I still cannot read Darwin's closing lines without experiencing a spinal shiver for the power of his prose—and without feeling great pride in having an intellectual hero with such admirable human qualities as well (the two don't mesh very often):

Those who look tenderly at the slave owner and with a cold heart at the slave, never seem to put themselves into the position of the latter; what a cheerless prospect, with not even a hope of change! Picture to yourself the chance, ever hanging over you, of your wife and your little children—those

objects which nature urges even the slave to call his own—being torn from you and sold like beasts to the first bidder! And these deeds are done and palliated by men, who profess to love their neighbors as themselves, who believe in God, and pray that his Will be done on earth! It makes one's blood boil, yet heart tremble, to think that we Englishmen and our American descendants, with their boastful cry of liberty, have been and are so guilty.

Thus, if we must convene a court more than 150 years after the event—a foolish notion in any case, although we seem driven to such anachronism—I think that Darwin will pass through the pearly gates, with perhaps a short stay in purgatory to think about paternalism. What then is the antidote to paternalism and its modern versions of insufficient appreciation for human differences (combined with too easy an equation of one's own particular and largely accidental way with universal righteousness)? What else but the direct and sympathetic study of cultural diversity—the world's most fascinating subject in any case, whatever its virtues in moral education. This is the genuine theme behind our valuable modern movement for pluralism in the study of literature and history—for knowing the works and cultures of minorities and despised groups

rendered invisible by traditional scholarship.

I don't deny that occasional abuses have been perpetrated by people who are overly zealous in this good cause; what else is new? But the attempt by even more zealous conservatives to distort and caricature this movement as a leftist fascism of "political correctness" ranks as a cynical smoke screen spread to cover a power struggle for control of the curriculum. Yes, Shakespeare foremost and forever (Darwin too). But also teach about the excellence of Pygmy bushcraft and Fuegian survival in the world's harshest climate. Dignity and inspiration come in many guises. Would anyone choose the tinhorn patriotism of George Armstrong Custer over the eloquence of Chief Joseph in defeat?

Finally, think about one more Darwinian line—perhaps the greatest—from the passages on slavery in the *Voyage of the Beagle*. We learn about diversity in order to understand, not simply to accept: "If the misery of our poor be caused not by laws of nature, but by our institutions, great is our sin."

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

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The Saltshaker's Curse

Physiological adaptations that helped American blacks survive slavery may now be predisposing their descendants to hypertension

by Jared Diamond

On the walls of the main corridor at UCLA Medical School hang thirty-seven photographs that tell a moving story. They are the portraits of each graduating class, from the year that the school opened (Class of 1955) to the latest crop (Class of 1991). Throughout the 1950s and early 1960s the portraits are overwhelmingly of young white men, diluted by only a few white women and Asian men. The first black student graduated in 1961, an event not repeated for several more years. When I came to UCLA in 1966, I found myself lecturing to seventy-six students, of whom seventy-four were white. Thereafter the numbers of blacks, Hispanics, and Asians exploded, until the most recent photos show the number of white medical students declining toward a minority.

In these changes of racial composition, there is of course nothing unique about UCLA Medical School. While the shifts in its student body mirror those taking place, at varying rates, in other professional groups throughout American society, we still have a long way to go before professional groups truly mirror society itself. But ethnic diversity among physicians is especially important because of the dangers inherent in a profession composed of white practitioners for whom white biology is the norm.

Different ethnic groups face different health problems, for reasons of genes as well as of life style. Familiar examples include the prevalence of skin cancer and cystic fibrosis in whites, stomach cancer and stroke in Japanese, and diabetes in Hispanics and Pacific islanders. Each year, when I teach a seminar course in ethnically varying disease patterns, these by-now-familiar textbook facts assume a gripping reality, as my various students

choose to discuss some disease that affects themselves or their relatives. To read about the molecular biology of sickle-cell anemia is one thing. It's quite another thing when one of my students, a black man homozygous for the sickle-cell gene, describes the pain of his own sickling attacks and how they have affected his life.

Sickle-cell anemia is a case in which the evolutionary origins of medically important genetic differences among peoples are well understood. (It evolved only in malarial regions because it confers resistance against malaria.) But in many other cases the evolutionary origins are not nearly so transparent. Why is it, for example, that only some human populations have a high frequency of the Tay-Sachs gene or of diabetes? In several of my columns I've discussed this evolutionary problem in connection with smallpox and hereditary tyrosinemia, as well as malaria (June 1988, February 1989, February 1990). This column will ask why hypertension (high blood pressure) should be the leading killer of American blacks.

Compared with American whites of the same age and sex, American blacks have, on the average, higher blood pressure, double the risk of developing hypertension, and nearly ten times the risk of dying of it. By age fifty, nearly half of U. S. black men are hypertensive. For a given age and blood pressure, hypertension more often causes heart disease and especially kidney failure and strokes in U. S. blacks than whites. Because the frequency of kidney disease in U. S. blacks is eighteen times that in whites, blacks account for about two-thirds of U. S. patients with hypertensive kidney failure, even though they make up only about one-tenth of the population. Around the world, only Japa-

nese exceed U. S. blacks in their risk of dying from stroke. Yet it was not until 1932 that the average difference in blood pressure between U. S. blacks and whites was clearly demonstrated, thereby exposing a major health problem outside the norms of white medicine.

What is it about American blacks that makes them disproportionately likely to develop hypertension and then to die of its consequences? While this question is of course especially "interesting" to black readers, it also concerns all Americans, because other ethnic groups in the United States are not so far behind blacks in their risk of hypertension. If *Natural History* readers are a cross section of the United States, then about one-quarter of you now have high blood pressure, and more than half of you will die of a heart attack or stroke to which high blood pressure predisposes. Thus, we all have valid reasons for being interested in hypertension.

First, some background on what those numbers mean when your doctor inflates a rubber cuff about your arm, listens, deflates the cuff, and finally pronounces, "Your blood pressure is 120 over 80." The cuff device is called a sphygmomanometer, and it measures the pressure in your artery in units of millimeters of mercury (that's the height to which your blood pressure would force up a column of mercury in case, God forbid, your artery were suddenly connected to a vertical mercury column). Naturally, your blood pressure varies with each stroke of your heart, so the first and second numbers refer, respectively, to the peak pressure at each heartbeat (systolic pressure) and to the minimum pressure between beats (diastolic pressure). Blood pressure varies somewhat with position, activity, and anxiety

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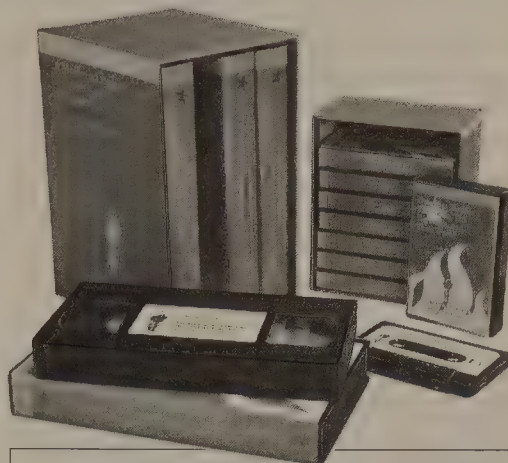
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level, so the measurement is usually made while you are resting flat on your back. Under those conditions, 120 over 80 is an average reading for Americans.

There is no magic cutoff between normal blood pressure and high blood pressure. Instead, the higher your blood pressure, the more likely you are to die of a heart attack, stroke, kidney failure, or ruptured aorta. Usually, a pressure reading higher than 140 over 90 is arbitrarily defined as constituting hypertension, but some people with lower readings will die of a stroke at age fifty, while others with higher readings will die in a car accident in good health at age ninety.

Why do some of us have much higher blood pressure than others? In about 5 percent of hypertensive patients there is an identifiable single cause, such as hormonal imbalance or use of oral contraceptives. In 95 percent of such cases, though, there is no such obvious cause. The clinical euphemism for our ignorance in such cases is "essential hypertension."

Nowadays, we know that there is a big genetic component in essential hypertension, although the particular genes involved have not yet been identified. Among people living in the same household, the correlation coefficient for blood pressure is 0.63 between identical twins,

who share all of their genes. (A correlation coefficient of 1.00 would mean that the twins share identical blood pressures as well and would suggest that pressure is determined entirely by genes and not at all by environment.) Fraternal twins or ordinary siblings or a parent and child, who share half their genes and whose blood pressure would therefore show a correlation coefficient of 0.5 if purely determined genetically, actually have a coefficient of about 0.25. Finally, adopted siblings or a parent and adopted child, who have no direct genetic connection, have a correlation coefficient of only 0.05. Despite the shared household environment, their blood pressures are barely more similar than those of two people pulled randomly off the street. In agreement with this evidence for genetic factors underlying blood pressure itself, your risk of actually developing hypertensive disease increases from 4 percent to 20 percent to 35 percent if, respectively, none or one or both of your parents were hypertensive.

But these same facts suggest that environmental factors also contribute to high blood pressure, since identical twins have similar but not identical blood pressures. Many environmental or life style factors contributing to the risk of hypertension have been identified by epidemiological

studies that compare hypertension's frequency in groups of people living under different conditions. Such contributing factors include obesity, high intake of salt or alcohol or saturated fats, and low calcium intake. The proof of this approach is that hypertensive patients who modify their life styles so as to minimize these putative factors often succeed in reducing their blood pressure. Patients are especially advised to reduce salt intake and stress, reduce intake of cholesterol and saturated fats and alcohol, lose weight, cut out smoking, and exercise regularly.

Here are some examples of the epidemiological studies pointing to these risk factors. Around the world, comparisons within and between populations show that both blood pressure and the frequency of hypertension increase hand in hand with salt intake. At the one extreme, Brazil's Yanomamö Indians have the world's lowest-known salt consumption (somewhat above 10 milligrams per day!), lowest average blood pressure (95 over 61!), and lowest incidence of hypertension (no cases!). At the opposite extreme, doctors regard Japan as the "land of apoplexy" because of the high frequency of fatal strokes (Japan's leading cause of death, five times more frequent than in the United States), linked with high blood

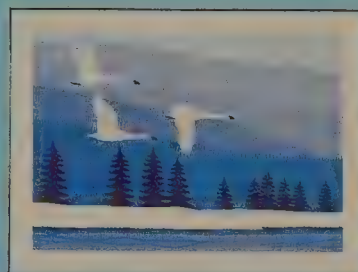
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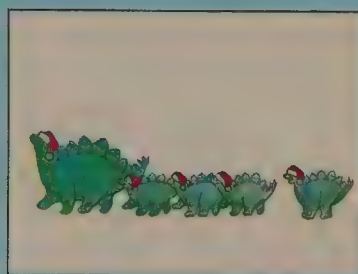
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pressure and notoriously salty food. Within Japan itself these factors reach their extremes in Akita Prefecture, famous for its tasty rice, which Akita farmers flavor with salt, wash down with salty miso soup, and alternate with salt pickles between meals. Of 300 Akita adults studied, not one consumed less than five grams of salt daily, the average consumption was twenty-seven grams, and the most salt-loving individual consumed an incredible sixty-one grams—enough to devour the contents of the usual twenty-six-ounce supermarket salt container in a mere twelve days. The *average* blood pressure in Akita by age fifty is 151 over 93, making hypertension (pressure higher than 140 over 90) the norm. Not surprisingly, Akita's frequency of death by stroke is more than double even the Japanese average, and in some Akita villages 99 percent of the population dies before age seventy.

Why salt intake often (in about 60 percent of hypertensive patients) leads to high blood pressure is not fully understood. One possible interpretation is that salt intake triggers thirst, leading to an increase in blood volume. In response, the heart increases its output and blood pressure rises, causing the kidneys to filter more salt and water under that increased pressure. The result is a new steady state, in which salt and water excretion again equals intake, but more salt and water are stored in the body and blood pressure is raised.

At this point, let's contrast hypertension with a simple genetic disease like Tay-Sachs disease. Tay-Sachs is due to a defect in a single gene; every Tay-Sachs patient has a defect in that same gene. Everybody in whom that gene is defective is certain to die of Tay-Sachs, regardless of their life style or environment. In contrast, hypertension involves several different genes whose molecular products remain to be identified. Because there are many causes of raised blood pressure, different hypertensive patients may owe their condition to different gene combinations. Furthermore, whether someone genetically predisposed to hypertension actually develops symptoms depends a lot on life style. Thus, hypertension is not one of those uncommon, homogeneous, and intellectually elegant diseases that geneticists prefer to study. Instead, like diabetes and ulcers, hypertension is a shared set of symptoms produced by heterogeneous causes, all involving an interaction between environmental agents and a susceptible genetic background.

Since U. S. blacks and whites differ on the average in the conditions under which they live, could those differences account

for excess hypertension in U. S. blacks? Salt intake, the dietary factor that one thinks of first, turns out on the average not to differ between U. S. blacks and whites. Blacks do consume less potassium and calcium, do experience more stress associated with more difficult socioeconomic conditions, have much less access to medical care, and are therefore much less likely to be diagnosed or treated until it is too late. Those factors surely contribute to the frequency and severity of hypertension in blacks.

However, those factors don't seem to be the whole explanation: hypertensive blacks aren't merely like severely hypertensive whites. Instead, physiological dif-

ferences seem to contribute as well. On consuming salt, blacks retain it on average far longer before excreting it into the urine, and they experience a greater rise in blood pressure on a high-salt diet. Hypertension is more likely to be "salt-sensitive" in blacks than in whites, meaning that blood pressure is more likely to rise and fall with rises and falls in dietary salt intake. By the same token, black hypertension is more likely to be treated successfully by drugs that cause the kidneys to excrete salt (the so-called thiazide diuretics) and less likely to respond to those drugs that reduce heart rate and cardiac output (so-called beta blockers, such as propranolol). These facts suggest

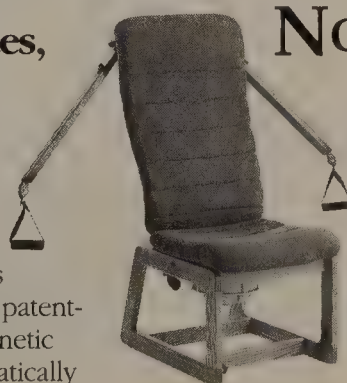


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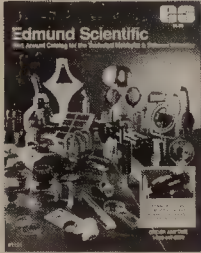
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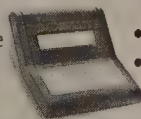
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that there are some qualitative differences between the causes of black and white hypertension, with black hypertension more likely to involve how the kidneys handle salt.

Physicians often refer to this postulated feature as a "defect": for example, "kidneys of blacks have a genetic defect in excreting sodium." As an evolutionary biologist, though, I hear warning bells going off inside me whenever a seemingly harmful trait that occurs frequently in an old and large human population is dismissed as a "defect." Given enough generations, genes that greatly impede survival are extremely unlikely to spread, unless their net effect is to increase survival and reproductive success. Human medicine has furnished the best examples of seemingly defective genes being propelled to high frequency by counterbalancing benefits. For example, sickle-cell hemoglobin protects far more people against malaria than it kills of anemia, while the Tay-Sachs gene may have protected far more Jews against tuberculosis than it killed of neurological disease. Thus, to understand why U. S. blacks now are prone to die as a result of their kidneys' retaining salt, we need to ask under what conditions people might have benefited from kidneys good at retaining salt.

That question is hard to understand from the perspective of modern Western society, where saltshakers are on every dining table, salt (sodium chloride) is cheap, and our bodies' main problem is getting rid of it. But imagine what the world used to be like before saltshakers became ubiquitous. Most plants contain very little sodium, yet animals require sodium at high concentrations in all their extracellular fluids. As a result, carnivores readily obtain their needed sodium by eating herbivores, but herbivores themselves face big problems in acquiring that sodium. That's why the animals that one sees coming to salt licks are deer and antelope, not lions and tigers. Similarly, some human hunter-gatherers obtained enough salt from the meat that they ate. But when we began to take up farming ten thousand years ago, we either had to evolve kidneys superefficient at conserving salt or learn to extract salt at great effort or trade for it at great expense.

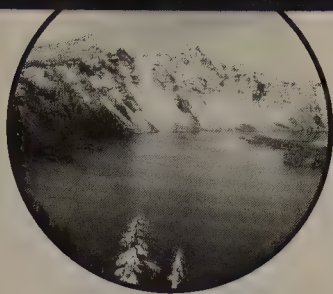
Examples of these various solutions abound. I already mentioned Brazil's Yanomamö Indians, whose staple food is low-sodium bananas and who excrete on the average only 10 milligrams of salt daily—barely one-thousandth the salt excretion of the typical American. A single Big Mac hamburger analyzed by *Consumer Reports* contained 1.5 grams (1,500 milli-

grams) of salt, representing many weeks of intake for a Yanomamö. The New Guinea highlanders with whom I work, and whose diet consists up to 90 percent of low-sodium sweet potatoes, told me of the efforts to which they went to make salt a few decades ago, before Europeans brought it as trade goods. They gathered leaves of certain plant species, burned them, scraped up the ash, percolated water through it to dissolve the solids, and finally evaporated the water to obtain small amounts of bitter salt.

Thus, salt has been in very short supply for much of recent human evolutionary history. Those of us with efficient kidneys able to retain salt even on a low-sodium diet were better able to survive our inevitable episodes of sodium loss (of which more in a moment). Those kidneys proved to be a detriment only when salt became routinely available, leading to excessive salt retention and hypertension with its fatal consequences. That's why blood pressure and the frequency of hypertension have shot up recently in so many populations around the world as they have made the transition from being self-sufficient subsistence farmers to members of the cash economy and patrons of supermarkets.

This evolutionary argument has been advanced by historian-epidemiologist Thomas Wilson and others to explain the current prevalence of hypertension in American blacks in particular. Many West African blacks, from whom most American blacks originated via the slave trade, must have faced the chronic problem of losing salt through sweating in their hot environment. Yet in West Africa, except on the coast and certain inland areas, salt was traditionally as scarce for African farmers as it has been for Yanomamö and New Guinea farmers. (Ironically, those Africans who sold other Africans as slaves often took payment in salt traded from the Sahara.) By this argument, the genetic basis for hypertension in U. S. blacks was already widespread in many of their West African ancestors. It required only the ubiquity of saltshakers in twentieth-century America for that genetic basis to express itself as hypertension. This argument also predicts that as Africa's life style becomes increasingly Westernized, hypertension could become as prevalent in West Africa as it now is among U. S. blacks. In this view, American blacks would be no different from the many Polynesian, Melanesian, Kenyan, Zulu, and other populations that have recently developed high blood pressure under a Westernized life style.

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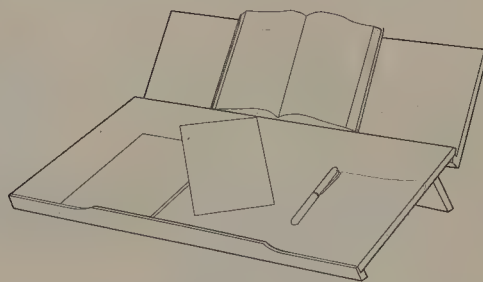


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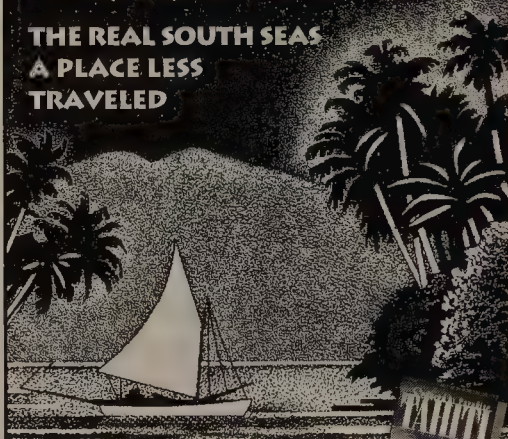
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this hypothesis, proposed by Wilson and physician Clarence Grim, collaborators at the Hypertension Research Center of Drew University in Los Angeles. They suggest a scenario in which New World blacks may now be at more risk for hypertension than their African ancestors. That scenario involves very recent selection for superefficient kidneys, driven by massive mortality of black slaves from salt loss.

Grim and Wilson's argument goes as follows. Black slavery in the Americas began about 1517, with the first imports of slaves from West Africa, and did not end until Brazil freed its slaves barely a century ago in 1888. In the course of the slave trade an estimated 12 million Africans were brought to the Americas. But those imports were winnowed by deaths at many stages, from an even larger number of captives and exports.

First, slaves captured by raids in the interior of West Africa were chained together, loaded with heavy burdens, and marched for one or two months, with little food and water, to the coast. About 25 percent of the captives died en route. While awaiting purchase by slave traders, the survivors were held on the coast in hot, crowded buildings called barracoons, where about 12 percent of them died. The traders went up and down the coast buying and loading slaves for a few weeks or months until a ship's cargo was full (5 percent more died). The dreaded Middle Passage across the Atlantic killed 10 percent of the slaves, chained together in a hot, crowded, unventilated hold without sanitation. (Picture to yourself the result of those toilet "arrangements.") Of those who lived to land in the New World, 5 percent died while awaiting sale, and 12 percent died while being marched or shipped from the sale yard to the plantation. Finally, of those who survived, between 10 and 40 percent died during the first three years of plantation life, in a process euphemistically called seasoning. At that stage, about 70 percent of the slaves initially captured were dead, leaving 30 percent as seasoned survivors.

Even the end of seasoning, however, was not the end of excessive mortality. About half of slave infants died within a year of birth because of the poor nutrition and heavy workload of their mothers. In plantation terminology, slave women were viewed as either "breeding units" or "work units," with a built-in conflict between those uses: "Those Negroes breed the best, whose labour is least," as an eighteenth-century observer put it. As a result, many New World slave populations depended on continuing slave im-

ports and couldn't maintain their own numbers because death rates exceeded birth rates. Since buying new slaves cost less than rearing slave children for twenty years until they were adults, slave owners lacked economic incentive to change this state of affairs.

Recall that Darwin discussed natural selection and survival of the fittest with respect to animals. Since many more animals die than survive to produce offspring, each generation becomes enriched in the genes of those of the preceding generation that were among the survivors. It should now be clear that slavery represented a tragedy of unnatural selection in humans on a gigantic scale. From examining accounts of slave mortality, Grim and Wilson argue that death was indeed selective: much of it was related to unbalanced salt loss, which quickly brings on collapse. We think immediately of salt loss by sweating under hot conditions: while slaves were working, marching, or confined in unventilated barracoons or ships' holds. More body salt may have been spilled with vomiting from seasickness. But the biggest salt loss at every stage was from diarrhea due to crowding and lack of sanitation—ideal conditions for the spread of gastrointestinal infections. Cholera and other bacterial diarrheas kill us by causing sudden massive loss of salt and water. (Picture your most recent bout of *turista*, multiplied to a diarrheal fluid output of twenty quarts in one day, and you'll understand why.) All contemporary accounts of slave ships and plantation life emphasized diarrhea, or "fluxes" in eighteenth-century terminology, as one of the leading killers of slaves.

Grim and Wilson reason, then, that slavery suddenly selected for superefficient kidneys surpassing the efficient kidneys already selected by thousands of years of West African history. Only those slaves who were best able to retain salt could survive the periodic risk of high salt loss to which they were exposed. Salt supersavers would have had the further advantage of building up, under normal conditions, more of a salt reserve in their body fluids and bones, thereby enabling them to survive longer or more frequent bouts of diarrhea. Those superkidneys became a disadvantage only when modern medicine began to reduce diarrhea's lethal impact, thereby transforming a blessing into a curse.

Thus, we have two possible evolutionary explanations for salt retention by New World blacks. One involves slow selection by conditions operating in Africa for millennia; the other, rapid recent selection by

slave conditions within the past few centuries. The result in either case would make New World blacks more susceptible than whites to hypertension, but the second explanation would, in addition, make them more susceptible than African blacks. At present, we don't know the relative importance of these two explanations. Grim and Wilson's provocative hypothesis is likely to stimulate medical and physiological comparisons of American blacks with African blacks and thereby to help resolve the question.

While this piece has focused on one medical problem in one human population, it has several larger morals. One, of course, is that our differing genetic heritages predispose us to different diseases, depending on the part of the world where our ancestors lived. Another is that our genetic differences reflect not only ancient conditions in different parts of the world but also recent episodes of migration and mortality. A well-established example is the decrease in frequency of the sickle-cell hemoglobin gene in U.S. blacks compared with African blacks, because selection for resistance to malaria is now unimportant in the United States. The example of black hypertension that Grim and Wilson discuss opens the door to considering other possible selective effects of the slave experience. They note that occasional periods of starvation might have selected slaves for superefficient sugar metabolism, leading under modern conditions to a propensity for diabetes.

Finally, consider a still more universal moral. Almost all people alive today exist under very different conditions from those under which every human lived 10,000 years ago. It's remarkable that our old genetic heritage now permits us to survive at all under such different circumstances. But our heritage still catches up with most of us, who will die of life style related diseases such as cancer, heart attack, stroke, and diabetes. The risk factors for these diseases are the strange new conditions prevailing in modern Western society. One of the hardest challenges for modern medicine will be to identify for us which among all those strange new features of diet, life style, and environment are the ones getting us into trouble. For each of us, the answers will depend on our particular genes, hence on our ancestry. Only with such individually tailored advice can we hope to reap the benefits of modern living while still housed in bodies designed for life before saltshakers.

Jared Diamond is a professor of physiology at UCLA Medical School.



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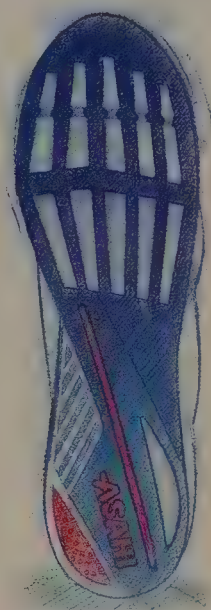
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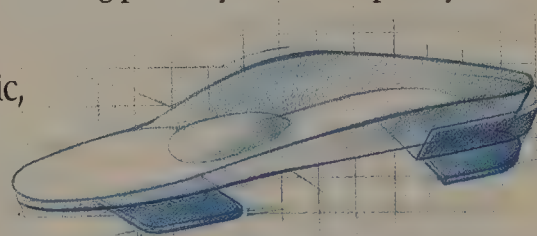
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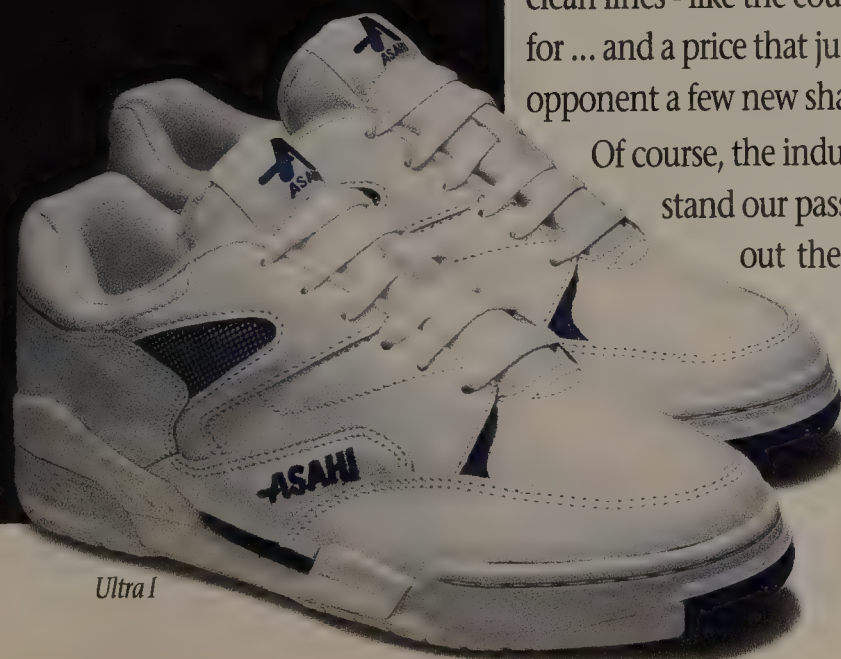


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CHIEFLY FEASTS

The Pacific Coast Indians of British Columbia have for generations validated and advanced their social status through lavish feasts and the exchange of elaborate material goods. The American Museum, in collaboration with Native Americans, will present "Chiefly Feasts: The Enduring Kwakiutl Potlatch," running from October 18 through February 23, 1992, in Gallery 3. The exhibition will focus on the potlatch ceremony and artifacts associated with it.

In a two-day symposium on the weekend of October 19 and 20, sixteen speakers, some of them Native Americans, will discuss various aspects of Northwest Coast art. Films and lectures, music and dance performances, carving demonstrations, and special children's programs will also be presented throughout the four-month duration of "Chiefly Feasts." Related articles appear in this issue of *Natural History* on pages 42 and 50. For a detailed schedule of events, call (212) 769-5305.

YEAR OF TIBET

From Friday, October 4, through Friday, November 8, forty-five dolls representing traditional Tibetan characters—merchants, masked dancers, monks, soldiers, and government officials—will be on display in the Hall of Birds of the World. Four artisan-monks will demonstrate the process of creating these eighteen-inch dolls, crafting fifteen new figures during their Museum visit.

A two-day film program will present classics, such as *Lost Horizon* and *The Horse Thief*, and ten other archival, documentary, and feature films. The program is free with admission to the Museum and takes place on Saturday and Sunday, October 12 and 13, from 11:00 A.M. to 4:30 P.M. in the Kaufmann Theater.

Austrian mountaineer Heinrich Harrer will talk about his life in the court of the Dalai Lama and his many years in Tibet on Thursday, October 17, at 7:00 P.M. in the Main Auditorium. Tickets are \$15. A selection of his Tibetan photographs will be exhibited in the Akeley Corridor.

Ritual dances from the "Vajrakilaya," an ancient Buddhist tantra, will be performed for the first time outside Tibet on Wednesday, October 16, at 8:00 P.M. in the Main Auditorium. Admission is \$20.

For more information about the Tibetan programs, call (212) 769-5305.

FALL LECTURE SERIES

Topics in this year's Fall Lecture Series range from the decline of life on earth, to be discussed by three Museum curators—

Judith Winston, Melanie Stiassny, and Ross MacPhee—to the natural history of parrots, a three-part series by Rosemarie Gnam of the Museum's Department of Ornithology.

David Watts, director of the Karisoke Research Center, will talk about his work with mountain gorillas in Rwanda. Renee Askins, researcher and director of the Wolf Fund, will lecture on wolf ecology and behavior, as well as reintroduction projects. Carolyn Gilman, guest curator for "The Way to Independence" exhibition, will talk about the changing lives of a Hidatsa Indian family.

To receive a brochure and to inquire about ticket availability for the Fall 1991 Lecture Series call (212) 769-5305.

MEMBERS' PROGRAMS

How sailors of antiquity crossed vast stretches of ocean has preoccupied modern-day explorers. Norman Baker, the navigator, radioman, and second-in-command of Thor Heyerdahl's third expedition, will give a slide-illustrated account of the voyage of the *Tigris*. Launched in the Tigris River, the boat sailed from Mesopotamia through the Persian Gulf to the Indus Valley and finally through the Red Sea, proving the link between the ancient civilizations of Sumeria, the Indus Valley, and Egypt. The program will take place in the Kaufmann Theater on Wednesday, October 23, at 7:00 P.M. Tickets are \$10 (\$7 for members).

In Huai Kha Khaeng Wildlife Sanctuary, covering about 1,000 square miles of Thailand, zoologist Alan Rabinowitz has studied and tracked civets, leopards, Indochinese tigers, and other wild cats. He will talk about the status of cats in Thailand, as well as around the world, on Wednesday, October 30, at 7:00 P.M. in the Main Auditorium. Tickets are \$10 (\$5 for Museum members and members of Wildlife Conservation International).

Founder of an academy of Mideastern and North African dance, Carolina Varga Dinicu will demonstrate the origins and history of Mideastern Oriental dance. Her workshop will be held on Friday, October 4, at 7:00 P.M. in the Kaufmann Theater. Tickets are \$8 (\$4 for members).

For children, naturalist Andrew Simons and his live menagerie of predators will be at the Museum on Sunday, October 6, at 11:30 A.M. and 1:30 P.M. The program costs \$8 (\$4 for members). Storyteller Laura Simms will offer an evening of tales for adults on Friday, October 25, at 7:00 P.M. and a daytime program for children on Saturday, October 26, at 11:30 A.M. and 1:30 P.M. The performances will take place in the Kaufmann

Theater. Adult tickets are \$10 (\$7 for members); children's tickets are \$8 (\$4 for members).

For information and ticket availability for members' programs, call (212) 769-5606.

CARIBBEAN MONTH

Afro-Cuban jazz percussionist Daniel Ponce will perform on Thursday, October 3, at 7:30 P.M. in the Main Auditorium. "Routes of Rhythm," a film series narrated by Harry Belafonte, traces the journey of Afro-Cuban music from its African and Spanish roots (Part 1) through its cultural blending in the Caribbean (Part 2) to its worldwide popularity (Part 3). The films will be shown at 7:00 P.M. on Friday, October 4, Thursday, October 10, and Friday, October 18, in the Linder Theater. To further celebrate Caribbean Month, lectures and demonstrations will be held each weekend in October at the Leonhardt People Center. Contact (212) 769-5315 for more information or for a flier with further details about these free programs.

UNDER THE STARS

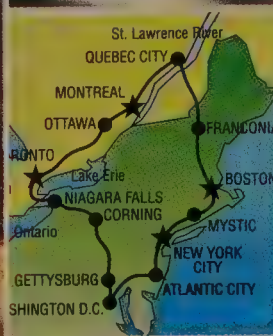
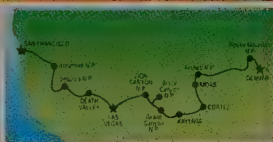
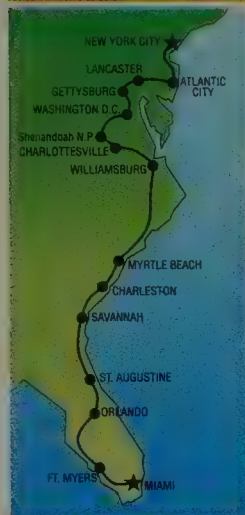
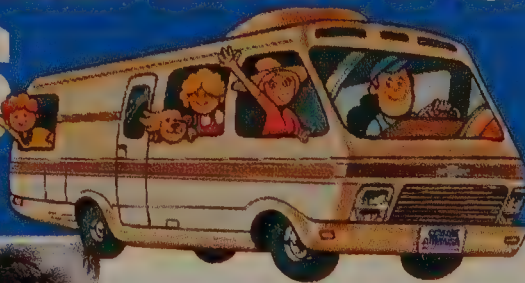
Two concerts of gamelan music from Indonesia will take place in the Planetarium's Sky Theater, on Wednesday, October 2, at 8:00 P.M. and Wednesday, October 16, at 7:30 P.M. As part of the show, photographs from Indonesia will be projected onto the domed ceiling of the Sky Theater. Tickets are \$12 (\$10 for members).

Astronomers now have satellites in space that pick up and chart X-rays, giving us vivid new pictures of stars and galaxies deep within the universe. David Helfand, chairman of the Department of Astronomy at Columbia University, will present an illustrated talk, "X-Ray Eyes on the Universe," on Monday, October 21. Part of the Frontiers in Astronomy and Astrophysics series, this lecture will take place in the Planetarium's Sky Theater at 7:30 P.M. Tickets are \$6 (\$5 for members).

For additional information about these and other Planetarium programs, call (212) 769-5900.

These events take place at the American Museum of Natural History, located on Central Park West at 79th Street in New York City. The Kaufmann and Linder theaters and the Leonhardt People Center are located in the Charles A. Dana Education Wing. The Museum has a pay-what-you-wish admission policy. For more information about the Museum, call (212) 769-5100.

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J.M.W. Turner, *The Lake, Petworth: Sunset, Fighting Bucks*, ca. 1828

Tate Gallery, London/Art Resource, New York
Photograph by John Webb

Lords of the Lek

*England's fallow deer bucks create
a common ground for attracting does*

by Tim Clutton-Brock

While he was staying with the third Lord Egremont at Petworth Park in Sussex in the autumn of 1828, the English landscape artist J. M. W. Turner painted a remarkable picture of the view from the great house. It depicts the gentle sunlight of early autumn seeping away to the western horizon, gilding the park's circles of century-old trees. In the center of the painting, two fallow deer bucks are fighting, while other males look on. To their right and left, herds of females are distributed across the park, grazing peacefully. Besides being the first, it is a beautifully detailed illustration of a mating system known to zoologists as lekking.

The Swedish word *lek* refers to a frozen lake used as an arena for sports and athletic contests. Zoologists have adopted the term to describe another kind of natural arena: an animal's traditional mating area where males hold small territories that are visited by females ready to mate. Once on



the lek, most females select the same partners; thus, only one or two males do most of the mating on a single day.

Lekking was first discovered in birds, such as the sage grouse, black grouse, ruff, and some tropical manakins, although it has also evolved among such widely disparate groups as Hawaiian fruit flies and hammerheaded bats. Although rare among large mammals, lek mating systems have been found among the Uganda kob and several other African antelopes.

One hundred and fifty-seven years after Turner painted his picture, I visited the Petworth estate for the first time. As a zoologist, my purpose was to investigate the mating system of the park's 900 fallow deer. Originally introduced into Europe from Asia Minor by the Romans, the species, known scientifically as *Dama dama*, has ranged in woodlands and parklands for almost two millennia. It had been reported that the Petworth deer had an un-

usual breeding system resembling a lek. In addition, lekking in a Danish population of fallow deer had recently been reported by French biologist C. R. Schaal.

Most male mammals establish exclusive access to individual fertile females, collect harems of several females, or in some cases, defend extensive territories where females regularly feed. The breeding system of the Petworth fallow deer was reported to be quite different: the largest males defended tiny territories, often no more than thirty feet across, which were clustered in one part of the park and visited by receptive females. These reports—and Turner's painting—strongly suggested to me that Petworth's fallow deer were using leks.

To my mind, lekking is the most puzzling of all mammalian mating systems. Why do males defend tiny, clustered territories instead of seeking out estrous females or defending permanent harems?

Do females really mate exclusively on the lek? and if so, why? And is it plausible, as has been suggested for birds, that females use leks to select male partners with the highest level of evolutionary fitness?

To determine what was actually going on at Petworth, I and a small team of observers, including zoologists David Green, Mariko Hiraiwa-Hasegawa, and Tony Robertson, first set about learning to recognize the mature bucks. Unlike most other deer, fallow bucks have webbed, or palmated, antlers, edged with a large number of small, irregular points. By drawing outlines of the bucks' heads, we could record their unique "antlerprints" and use them to identify individuals.

By early October, many mature bucks are already defending territories under oak trees, which they mark by scraping and urinating on the ground. At the height of the mast, or nutting, season, a big oak will drop up to 10,000 acorns a day, many



Manfred Danegger; NHPA

of which are avidly eaten by does that gather under the trees. We wondered, were female social groups just congregating wherever food was distributed in their habitat? The defense of territories under oak trees by mature bucks appeared to support this interpretation. If so, perhaps real leks did not exist and males merely defended local resources that attracted groups of females.

As an experiment, on three successive evenings we spread acorn-sized food pellets under ornamental oaks that did not produce acorns. As we expected, groups of feeding does quickly collected under these trees, and mature males established territories there. Meanwhile, on what was (according to park keepers) the traditional lek, all was quiet. A few old and somewhat ragged males intermittently defended boundaries in the vicinity, but does rarely visited the area, and there was little competition for territories.



Fallow deer bucks, left, fight to determine dominance on the periphery of the lek, or mating ground. Once established on his own small territory there, an adult male, bottom left, spends hours "groaning" to attract females to his harem. The "chin-up" display, below, which is not well understood, is often given by territorial males when a rival approaches.

Stefan Meyers; Okapia/Photo Researchers



any buck whose attention was diverted or to chase any doe that strayed beyond a territorial boundary. Meanwhile, the successful bucks groaned repeatedly, raising a chorus of low, guttural, bullfroglike mating calls.

As I watched, a courtship sequence began on one of the small territories. The defending buck nosed the rump of a dark doe that had ventured onto his turf. She started to run, and he chased her briefly around his plot. When he stopped and groaned repeatedly, the doe licked her rump, stared at him, and finally allowed him an awkward mounting. Over the next few minutes, he attempted to mate a dozen times, finally achieving a successful coupling and ejaculation. Afterward, the doe, standing in a strained posture, urinated copiously, and then lay down in a clump of rushes. Ten minutes later, she rose, stretched, and then ran out of the buck's territory. A neighboring buck quickly herded her onto his own patch, but the moment his attention was distracted she ran off the lek altogether and began to graze, gradually moving back to one of the female herds feeding among the oak trees. To my surprise, when she left the lek, none of the younger males tried to molest her.

During the rest of the day, we counted nine more mating sequences on the lek, all of them similar to the first. The next day

there were ten, and two days later, thirty. Each sequence was roughly similar. Does moved to the lek alone or in small groups, often chased by young males. They would spend about a day on the lek, moving between the territories of different bucks once or twice an hour. Subsequently, they entered full estrus and began to be mounted by the buck whose territory they were in. Eventually, they stood still while he completed copulation. Less than 6 percent of the does mated a second time—never with the same buck—before drifting back to the female herds grazing outside the lek. As soon as they had copulated, the behavior of does changed and they were no longer a source of intense interest to males. To my amazement, virtually no matings occurred on the feeding territories under the oak trees, now defended by younger or smaller bucks. Over the next two weeks we saw 212 matings on the lek but only 14 on feeding territories or in other areas of the park.

Off the lek, bucks commonly held the same patch of ground for more than a month, throughout October and early November. While on the lek, the bucks typically defended their areas for a much shorter period—in the case of the most successful bucks this was often less than a week. During their period of tenure, the most successful animals mated with as

As October wore on, I became increasingly convinced that fallow deer did not use the lek system at all. Some of the biggest bucks were defending feeding territories under oak trees, and it seemed reasonable to expect that most of the mating would occur there. At the end of the third week of October, my skepticism was confirmed when the first brief, clumsy matings took place under one of the most productive oak trees.

The next day, I awoke to find that the entire situation had changed overnight. Ten of the largest males had vacated their feeding grounds and were now defending small, discontinuous territories based around clumps of rushes on the traditional site of the lek. Small harem groups of does stood or lay on these territories, busily defended by the territorial bucks. Just outside and between these well-defined patches milled a restless mass of young males, ready to dash into the territory of

*A territorial buck, below, mounts an estrous doe.
Right: On the edge of the lek, a buck tries to herd his
wandering does together, while alert young males watch
for any opportunity to cut them out of the harem.*

Photographs by Tim Clutton-Brock



many as twelve does per day or up to thirty in three days. Observations with image intensifiers showed that mating continued throughout the night, and the number of matings may have doubled while we slept. What we saw confirmed that the fallow deer at Petworth do indeed mate almost exclusively on the lek, and that a small proportion of males are responsible for most of the matings. But why has this system evolved?

One explanation offered for the lek-breeding systems of other species is that females gather in particular areas to find food, and males defend these "hot spots" to insure a regular supply of females. At Petworth, however, females do little feeding on the lek, and nothing indicates that the grazing there is superior to that in other parts of the park. When we scattered food pellets on the lek itself, we found this had no effect on the distribution of does, although it soon attracted a circle of hungry young bucks.

Another possibility is that mating on the lek enables females to choose genetically superior mating partners. One version of this theory argues that preferred males are generally healthier, stronger, and more vigorous, carrying a higher proportion of "good genes" to bequeath to their descendants. Another argument maintains that the selection of good genes

is not crucial; females may benefit from mating with attractive partners because attractiveness itself is perpetuated. The sons of attractive males will resemble their fathers and will become the preferred mating partners in the next generation.

Both theories, however, indicate that females should consistently prefer to mate with particular partners. Among species that use leks, some males are dramatically more successful at mating than others, and fallow deer are no exception. On any given day, one male may perform three-quarters of all matings. Since bucks seldom mate for more than four or five days during the entire rutting season, the most successful individual is responsible for as much as 12 to 18 percent of the year's total matings. We found that bucks that achieved such a high rate were usually larger than average, more successful in territorial fights with other bucks, and called and groaned more than their rivals.

In the eighteenth century, Charles Darwin's grandfather Erasmus first interpreted the high mating success of "fitter" bucks as evidence of female choice. However, there are other plausible explanations. For instance, in some species, the better fighters (stronger, healthier, larger individuals) may mate more frequently because they are able to fend off rivals, overriding selection by females. Where



males defend territories, as in fallow deer, larger, stronger males may win access to preferred territories, thus generating a correlation between male size and mating success that does not depend on female preferences for particular males. Zoologist Andrew Balmford has shown that among Uganda kob, whose males defend tiny, clustered territories like those of fallow deer, females prefer to mate on particular territories and will return to the same territory even if its resident male has been replaced by another.

The only way we could attempt to test whether females were choosing specific males rather than the territories they occupied was to remove males from their patches and see if they were equally successful on other territories. To do this, during the rut of 1988 we waited until the lek was established and we could assess the relative mating success of different bucks. We then pinned 32-square-foot



sheets of black polyethylene in the centers of the territories to reduce their attractiveness as mating places. Although the bucks continued to defend territories with black sheets on them, the does refused to settle there, and mating immediately fell to zero. After a day or so, the bucks moved away and started to defend new territories about 600 feet from the original area. Several bucks that had held central territories on the old lek shifted to more peripheral sites on the new one, but their relative mating success closely matched their performances on the original sites. This experiment showed that females were more interested in the bucks than in the position of their territories.

Detailed observation of the movements of does on the lek showed that they copied one another. Does entering the lek displayed a strong preference for joining the largest harems, usually heading directly for those bucks that already had the most

does. Those moving between territories usually gravitated toward a bigger harem than the one they came from. And when a buck began to mate with a doe, others rushed over to join his harem.

However, evidence that females prefer particular mating partners does not necessarily indicate that they gain genetic benefits from mate choice or that they visit leks for this reason. In many bird species, where fathers help to care for their offspring, females choose males that are able to contribute more than average parental care, thereby increasing the number of young that they can rear. In lek-breeding mammals, males do not assist in rearing their offspring, so this explanation cannot apply. However, there may be other direct benefits that females can gain by mating with particular males.

In ungulates, females in estrus are often harassed by young males. Simultaneous courtship by multiple, inexperienced

males may endanger them. Yearling fallow bucks carry the equivalent of two six-inch nails sticking out of their heads, and females go to considerable lengths to avoid them. All lek-breeding ungulates live in large herds of unstable membership. In these, males may be unable to establish dominance hierarchies that could protect estrous females from harassment. Females in estrus may be attracted to the lek because they are safest there. Even though young males gather near the larger harems, chasing out does when the defending buck's attention is diverted, females on the lek can avoid prolonged chases by running onto a neighboring territory. Also, does are less likely to be harassed in larger harems and may prefer to join them for this reason.

To test the possibility that estrous females were moving to the lek to avoid harassment, we needed to compare rates of sexual harassment on and off the lek.

A mature buck defends a large harem of anestrus does under an oak tree.

Owen Price

Since females in estrus are rarely seen off the lek, we gently herded them outside its boundaries just before copulation would have occurred. The results were striking. On the lek, estrous does were chased between territories by young bucks about three times per hour. Off the lek, does were harassed more than twice as often. They commonly attracted a retinue of young bucks that pursued them for several hundred yards until they entered a mature buck's territory or reentered the safety of the lek. In some cases, a distressed doe finally gave in and mated with one of the persistent yearlings—a behavior we had never previously seen.

Bucks may benefit from defending clustered territories because females prefer to mate there. However, there is another reason why defending clustered territories instead of evenly spaced, isolated ones may be an advantage. Even the most successful bucks have their territories totally emptied of does about once an hour as a result of intrusions by young bucks. On the lek, bucks that lose their harems as a result of such intrusions regain some does within a few minutes as other harems are disrupted in their turn. Harassment by young bucks seldom causes does to leave the lek altogether, and bucks that hold territories there share in a revolving pool of does that move continually among their harems. Bucks that hold isolated territories do not suffer such high rates of intrusion by young males. But when their harems are disrupted, their does are chased far away and the bucks are seldom able to reestablish a harem on the same day.

It has taken us five seasons of intensive work to reach even this preliminary understanding of what is going on at Petworth. Yet most of the elements of the fallow deer's mating system are clearly illustrated in Turner's picture: the large herds of grazing does; the solitary females moving among males; the big bucks fighting for central territories on the lek; and the surrounding fringe of smaller, nonterritorial bucks. I often wonder just how much Turner understood about Petworth's fallow deer. The observations he rendered in oil remain startlingly accurate to a scientist's eye. □





Color photographs by Jeff Jacobson

At a September 1990 potlatch hosted by Robert Joseph, his nephew Cecil Dawson, below, wearing red cedar bark regalia, performs the hamatsa, in which an initiate is possessed by a cannibal spirit, during the first and most important dance of the potlatch cycle. Right: Chief Willie speaks at the American Museum in 1990.



Masks of the Ancestors

Kwakiutl dancers re-create a legendary adventure

by Aldona Jonaitis and Peter Macnair

Mocked by his father for laziness, Siwidi (Paddled-To) was sitting despondently beside a large lake, when mysteriously he was engulfed by an octopus and dragged down to the magnificent house of the Undersea Chief. This benefactor sent the young man, accompanied by killer whales, on a series of visits to the tribes beneath the sea, where he encountered various creatures. Four years later (although to him it seemed just four days), Siwidi returned to the Undersea Chief,



Denis Finnin, AMNH

who bestowed on him his wonderful house and gave him great spiritual power and new names, including Born-to-Be-Head-of-the-World.

Then Siwidi floated up, house and all, to the vicinity of his home village among the Kwakiutl people of the Northwest Coast. There he appeared to his family in different guises before finally becoming a man again, a great leader whose physical and intellectual powers surpassed those of other mortals. Siwidi also brought with him the right to perform a masquerade of his adventures, along with the necessary paraphernalia. This he did at a great potlatch attended by people from all the Kwakiutl communities, who were impressed by his chiefly rank and power.

Now the privilege of presenting the dance about this legendary hero and his undersea adventures is claimed by just a few Kwakiutl belonging to a small number of related families. Prominent among these is Tom Willie, an eighty-year-old chief of the village of Hopetown, located on an island near the mainland. Tom Willie confirms his claim by presenting the masked dance at potlatches that com-

memorate an important life event for one of his relatives.

In 1985 Chief Willie presented the dance at the raising of a totem pole erected in the village as a memorial for the late chief Fred Williams. In the audience was one of the authors—Peter Macnair—whose close association with the Kwakiutl during the past twenty-five years has enabled him to attend numerous such events. When he was later asked by the Campbell River Museum on Vancouver Island to help with the planning of a new exhibit of Kwakiutl culture, Macnair thought a display of the type of masks used at this dance would have a great impact. And so, by formal arrangement with Chief Willie, in 1989 a set of two dozen masks was commissioned from contemporary Kwakiutl artists.

Macnair invited some twenty accomplished artists, including Tony Hunt, Calvin Hunt, and Richard Hunt, to prepare masks representing characters in the ancient, magical story. The results were gratifying, as the artists were highly motivated, knowing their creations would be worn in the community. By the terms of the agreement, the Campbell River Museum may display the new masks, but

The special exhibition "Chiefly Feasts: The Enduring Kwakiutl Potlatch" will premiere at the American Museum of Natural History on October 18 and run through February 23, 1992. The Wewanagila Dance Company of Hopetown Village will perform the masquerade of Siwidi's adventures in the Undersea Kingdom on November 29, December 1, and December 6.

Chief Willie retains the right to use them for traditional purposes. To date they have appeared at four potlatches; the presence of so many masks, many of them unfamiliar, has delighted Kwakiutl both young and old.

One of these potlatches was hosted by Chief Willie's wife, Elsie Williams, and her relative Robert Joseph. The event lasted three days and was attended by about 200 guests; some had traveled more than 300 miles for the occasion. For the

In the Siwidi dance cycle, more than two dozen sea creatures are called, one by one, onto the dance floor by Sea Eagle, below. The masked and costumed performer approaches the entranceway whistling and peeping to announce each successive dancer. Right: Peter Macnair examines a whale-bullhead mask, part of the Siwidi group found at the American Museum.





dance of the undersea creatures, Chief Willie and other chiefs sang songs introducing each character and explaining something about its role in the myth. As they sang, a succession of masked dancers performed, beginning with Sea Eagle and his assistant, Sea Raven. The two called forth the other masks, which entered one at a time.

One was the mask of the Bullhead, which opened to reveal the face of Siwidi inside. Its transformation enacted an epi-



Denis Finnin, AMNH

sode in the myth when Siwidi returns as a fish and is caught by his brother. Taken back to the mortal world, he then reveals his identity. As the dance progressed, the dancers who had completed their roles remained on the dance floor, so that at the end all the masks were on display. Then the dancers exited and reappeared without their masks.

Meanwhile, in preparation for the "Chiefly Feasts" exhibition, researchers at the American Museum were sorting through the hundreds of Kwakiutl artifacts collected at the turn of the century by Museum anthropologist Franz Boas, with the help of George Hunt, an Indian guide and Kwakiutl expert. Boas was among the many anthropologists who considered it their mission to document traditional cultures before they vanished or were transformed by Western contact. Although at the time the Kwakiutl were resisting a Canadian law prohibiting the potlatch, Boas predicted that the custom would eventually become extinct.

The Kwakiutl treasures stored at the Museum included many masks and decorated feast bowls related to the potlatch.

Host Robert Joseph's daughter Shelley, below, holds her infant daughter, Stephanie, prior to the formal naming of the child. Right: Dancers await their turn to enter the ceremonial house for the Siwidi dance. Wearing an octopus mask, the performer on the left will circle the fire in the dance house, imitating the movements of an octopus under water.



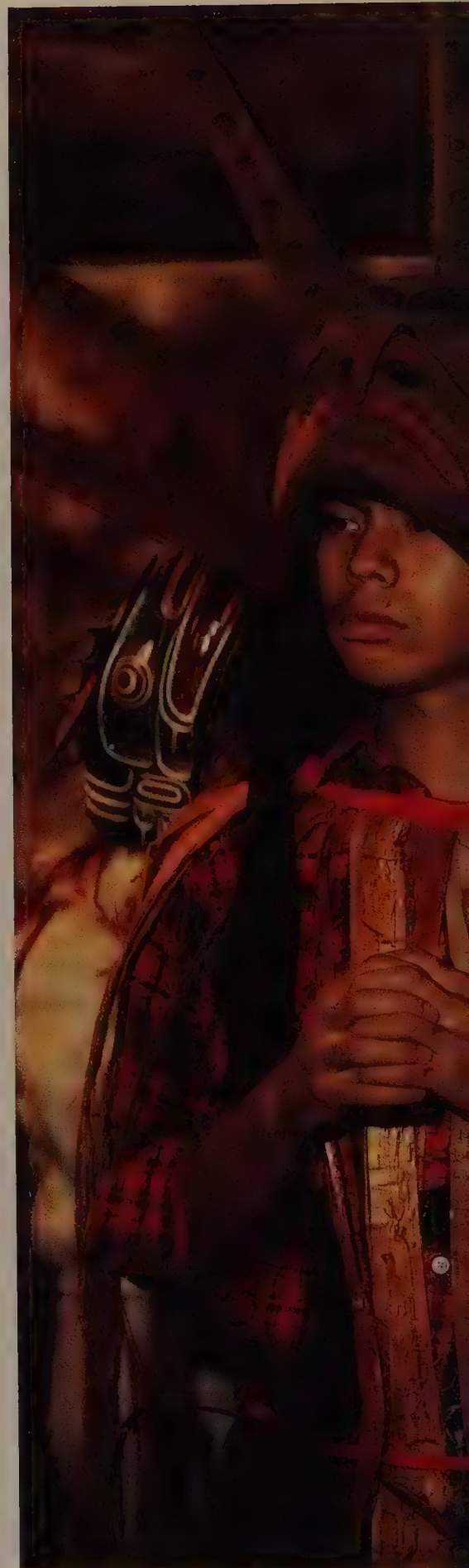
Among the masks were a number depicting sea creatures, including a whale, dogfish, bullhead, otter, and raven of the sea. Most of these pieces had apparently been left untouched for decades and were not even stored together. But when, in 1989, Macnair was called in as a consultant, he suspected they might have been used in earlier dramatizations of the Siwidi story. Careful examination of Hunt's numerous notes and published texts confirmed that he had, over a period of time, sought out various masks all relating to this one important legend. As a result, the thematically interrelated carvings became one of the highlights of the exhibition.

During preparation of the exhibition, an effort was made to inform the Kwakiutl of the Museum's plans and to benefit from their advice. Visits were paid to the residents of Kingcome, Alert Bay, Fort Rupert, Gilford Island, and Hopetown so that they could see and comment on photographs of the artifacts. To carry this process a step further, in May 1990 a delegation of elders was invited to New York City to review the proposed selection of objects and the wording of the related captions. The visitors provided informa-

tion about the meaning and use of the various pieces, linking the nineteenth-century artworks to their present ceremonial practices.

Among those who gathered in the anthropology department's large, fourth-floor storeroom at the Museum was Chief Tom Willie. When the turn-of-the-century masks associated with the legend of Siwidi were placed before him, he proudly recited his inherited version of the story in Kwakwaka, the Kwakiutl language. For a brief time the fluorescent-lit, linoleum-floored space lined with gray metal cabinets was transformed into a Kwakiutl "big house," the great community building where dances are performed.

Reflecting later on the experience of seeing the masks at the Museum, Chief Willie spoke with mixed emotion: "At first it made me sad to see all the masks that must have been sold or traded away before my time, and I wished my old people were still alive so that I could talk to them about the masks. But then I took pride remembering they had told me that every mask in the original set was made by a different carver. The masks represent the great achievements of many of our people." □





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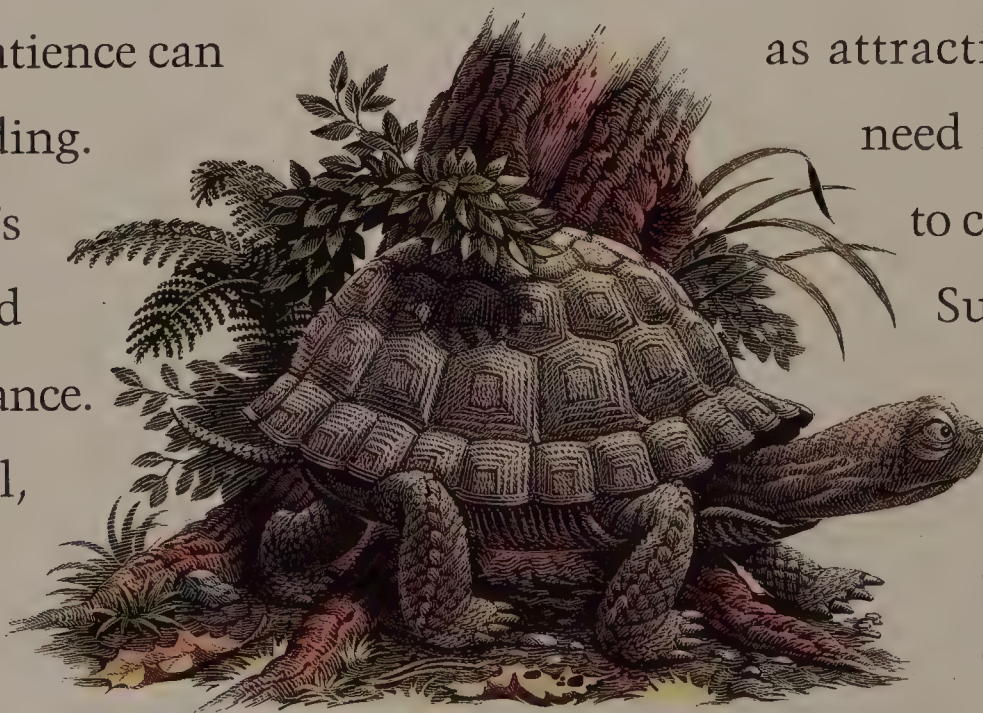
As you recall, it was the impatient hare who looked so

promising at first. Yet, it was the dogged determination and single-mindedness of the tortoise that triumphed in the end.

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Underground Potlatch

How the Kwakiutl kept the faith

by Douglas Cole

During Christmastide 1921 Dan Cranmer, a Nimkish Kwakiutl from Alert Bay on the coast of British Columbia, hosted a five-day ceremony of dances and gift giving. Part of his accumulated wealth consisted of property and family prerogatives his wife's family had transferred to him as part of the traditional "repurchase" of the bride. Now the 300 or so assembled guests witnessed Cranmer's giving away of all the property he had received, as well as more from his own and his family's resources.

Among the first items given away were twenty-four canoes, pool tables for two chiefs, four gasoline boats, and another pool table. Blankets, gaslights, violins and guitars, kitchen utensils and sewing machines, gramophones, bedsteads and bureaus, and 300 oak trunks followed. Dresses, shawls, and bracelets were given to women; sweaters and shirts to young people. Change was thrown up for the children to collect. On the fifth and last day of the ceremony came hundreds of sacks of flour, each worth three dollars. This was Cranmer's famous potlatch, one of the largest ever recorded among his people.

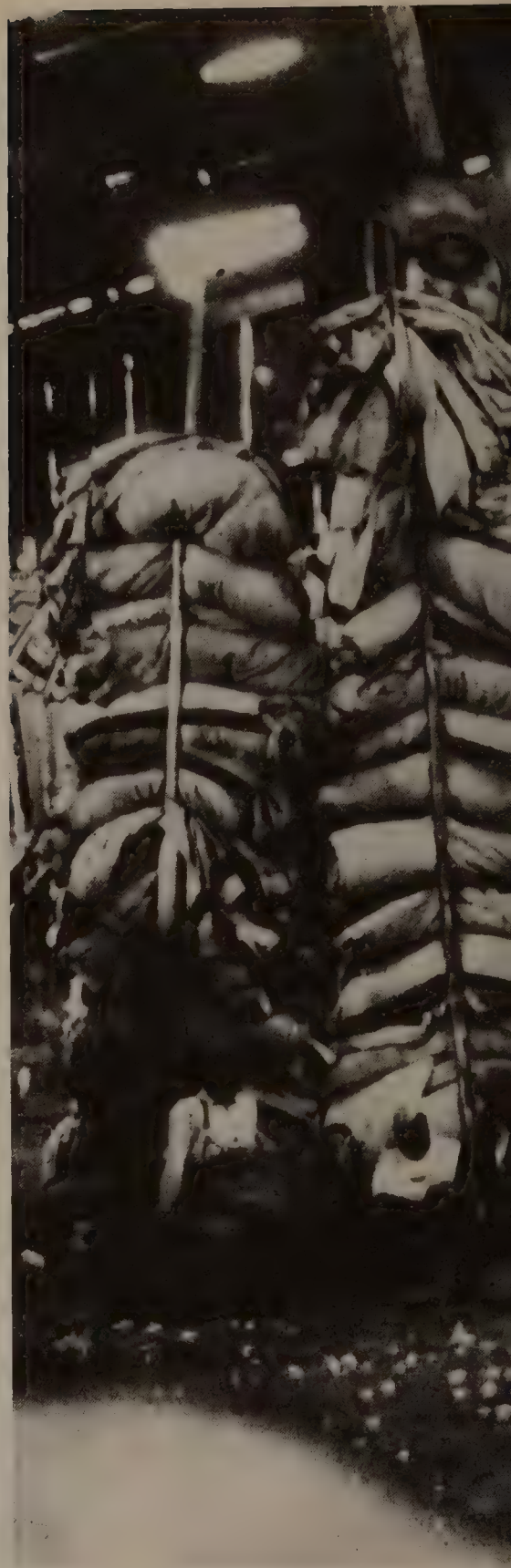
Dan Cranmer's potlatch became famous not only because of the volume of the gifts that changed hands over those December days but also because it brought criminal charges against fifty-one of those who attended. Twenty-two went to prison for two months, and the rest were given suspended sentences on the condition that they "voluntarily surrender" their dance masks, ceremonial whistles, plaques of beaten copper, and other potlatch paraphernalia. The potlatch, the ceremony

that Cranmer celebrated with his relatives and friends, was illegal under Canada's Indian Act of 1885.

The potlatch had been a custom widespread among the Indians of the Northwest Coast, from Alaska to Oregon (the word derives from the Nootka *patshatl*; the Kwakiutl term was *P!Esa'*). It was the ceremony in which one person bestowed traditional names, ranks, and privileges upon another, a public event that gave the transfer general validation. The occasions included the naming of a child, marriage and the redemption of a bridal payment, and death (when a relative would assume the name and position of the deceased). The distribution of property was meant as payment to the guests, who served as witnesses and, in turn, had their own status confirmed by their presence and the size of the gifts they received.

Much like the ball that marks a debutante's coming out into society or the bar mitzvah that heralds a Jewish boy's elevation to manhood, the potlatch celebrated a change of rank or status with dancing, feasting, and gifts. Like many other societies, those of the Northwest Coast associated prestige with wealth, and the potlatcher gained prestige according to the liberality of his giving. A true chief "always died poor" because he had potlatched his wealth, but he died rich in the rank and honor that he had accumulated for himself through giving and that he would pass on to his family, heirs, and descendants.

This social system, based on the distribution of wealth, was alien to European society and everywhere came under attack by missionaries and government offi-



cials. The accumulation of goods merely for giving away seemed to them to produce indigence and thriftlessness, "habits inconsistent with all progress." "It is not possible," wrote an early commentator, "that the Indian can acquire property, or can become industrious with any good result, while under the influence of this mania." It was, agreed a leading legislator, an "insane exuberance of generosity." Such reasoning led the Canadian government to ban the ceremony.

At the same time, legislators also outlawed what they called tamananawas, secret society rituals that included ceremo-



Stacks of Hudson's Bay Company blankets, left, await distribution to guests at a circa 1897 Kwakiutl potlatch. Photographed in 1894, Kwakiutl chief Wakgas of Koskimo, below, holds a "copper," a shield-shaped plaque of beaten copper. Because coppers were obtained through ritual exchange, they were invested with immense value.

U.S. National Museum



ans gradually began to give up the potlatch or modify it to accommodate European ways. This was not true of the Kwakiutl, however. Among these people, who lived along the inland coast of Vancouver Island and the adjacent mainland, the potlatch went on, perhaps even increased in the decades after the passage of the antipotlatch law. Their "incorrigibility" probably had something to do with the hazy gradation of rank within Kwakiutl society and the ability to obtain new rank through marriage, even multiple marriages, and the attendant potlatches. A defiant attitude toward the white man's law may have contributed. For whatever reasons, the Kwakiutl stood out as inveterate potlatchers. As Indian agent William Halliday reported in 1912, "There is no decrease in the number of potlatches held nor is its influence apparently less."

The federal government in Ottawa, in the person of the civil servant responsible for Indian affairs, Deputy Superintendent General D. C. Scott, decided to enforce the law. According to the 1911 census, Indians made up only 5 percent of the province's population. Railways or steamships penetrated almost all the coastal channels and rivers, and gasoline boats were available to most police detachments and agents. Reduced in numbers, loyal and law abiding (if sometimes law avoid-

nial cannibalism. These rituals were practiced along portions of the coast. Most notable was the *hamatsa* of the Kwakiutl, in which an initiate possessed by a cannibal spirit devoured human flesh (or pretended to) until the powerful forces within him were tamed. Such practices actually expressed repugnance at inhuman behavior but were acted out in a way that horrified white Canadian society.

Passing laws in Ottawa was easy, although even there skeptical lawmakers warned of the difficulty of enforcement in British Columbia. Prospects of preventing the potlatch were not very favorable, since

Indians living in the province were widely scattered in areas remote from police, magistrates, and the few agents appointed to supervise them. In the first attempt at enforcement, Indian resistance forced a hasty retreat; in the second, the case was thrown out of court when an unsympathetic judge insisted on a clear definition of what was outlawed. Most white residents opposed enforcement, seeing little harm in the ceremony and wishing no unnecessary provocation to threaten the generally friendly relations with the Indians.

Nevertheless, under the influence of missionaries, most of the province's Indi-

ing), and often intimidated by the power and paternalism of white authority, British Columbia's native population was not something to be feared. Indians, although they might resist passively, were impotent. Initially, local judges and jurors refused to convict or impose sentences, but soon a number of prison terms were given to potlatchers. The first convictions were in 1919; the first prison terms in 1920. Others followed the next year, culminating in the mass trials of the Cranmer potlatch participants in February and April of 1922. Swift and thorough, the prosecutions seemed to have worked, and agent Halliday declared the potlatch dead.

The Kwakiutl were loath to see so sudden an end to a ceremony they regarded as "one of our oldest and best customs." "We don't see any fault in it," they wrote; it was "a good thing for us all." They sent a delegation to Ottawa, hired lawyers, petitioned the government, and sought the support of their local member of Parliament. Most of all they asked for an impartial investigation. Convinced that nothing was wrong with their ceremony, they were confident that a commission, perhaps just "a good straight man," would conclude that the whole law was an unjust mistake. But petitions, lawyers, and appeals had no effect on Deputy Superintendent General Scott, who was convinced that the potlatch stood in the way of Indian progress and hampered their assimilation into Canadian civilization. Unable to secure even an investigation, the Kwakiutl fell back upon their own resourcefulness.

Within a few years the Indians established a pattern of evasion. They did not hold potlatches openly at Alert Bay, the home ground of agents and police, but transferred them to distant or inaccessible villages. The most notable was Gwayi at Kingcome Inlet, a village located two miles up a shallow, snag-ridden river that froze over in winter. It was sixty miles away from Alert Bay, and the only regular route to it was by steamer from Vancouver and then by gas boat upriver. Surprise was impossible: Gwayi was so situated that any approach, day or night, could be seen. The village's security was irksome to agents. They proposed to break it by dis-

guise, by stationing a policeman there, even by using seaplanes, but all such proposals proved impractical or too expensive. The Gwayi fortress remained unbreached.

Other villages, isolated in winter, were also used. In the early 1930s, frequent potlatches were held at Village Island, only fifteen miles from Alert Bay, with fishing boats carrying the goods from Alert Bay. Turnour Island, Fort Rupert, and Cape Mudge were also scenes of clandestine potlatches. "If there is nobody to watch," reported anthropologist Franz Boas, "they do whatever they like."

While such uncompromising potlatches increased after 1927, some Indians sought a means to potlatch more conveniently and closer to home. When Jane Nowell married Arthur Shaughnessy, the groom's payment was given privately, with only the chiefs present. A church wedding was followed by a feast and dance "in the white man's way," but Charlie Nowell, the bride's father, announced that everyone could go to the movies free on Saturday night, and he bought candy, cakes, and fruit to distribute there. Later, when one of the young couple's daughters died, men were sent around the village with \$300 to give away.

House-to-house visits satisfied obligations but took away much of the potlatch's significance. Songs and dances, vital components of the ceremony, could not be presented on a doorstep. So the Indians, with the advice of Vancouver lawyer W. R. Vaughan, invented the "disjointed potlatch." Separating the ceremonies from the gift giving, the Kwakiutl thwarted the Indian Act's specification that the giving-away must form part of an Indian ceremony. Authorities had great difficulty proving that gifts given on one day formed part of a dance held six months before.

The first disjointed potlatch that came to the attention of the Department of Indian Affairs was at Village Island, where 1,500 sacks of flour were given away but no dance or ceremony took place. On a second occasion, at Kalokwis village, Henry Speck held a large dance with all the old ceremony but gave nothing

A turn-of-the-century Kwakiutl dance mask representing an eagle, below, opens to reveal a human face, right. To effect the transformation, the performer pulled a string to snap the mask open at the proper dramatic moment.

Both photographs courtesy of AMNH



away—yet he recorded all his guests' names in a book and assured them he would give things away in six months. Agent Halliday saw a dance at Fort Rupert but had no evidence "that even a five cent piece had been given away." The flour distributions were particularly irritating. The man who delivered 1,500 sacks to Village Island left them with the remark, "Here is some flour I have brought to help you over the hard winter." And when Charlie Nowell landed 900 sacks at Fort Rupert, he brazenly told police that it was nothing more than "an act of Christian charity for the benefit of poor people."

There were other expedients. Feasts blended into Christmas dinners, and potlatch gifts were wrapped as holiday presents. In Alert Bay in December 1934, Moses Alfred simply tagged each item within a great heap of goods with the name of the person for whom it was intended and walked away. Such evasions depended upon the solidarity of the Kwakiutl. No one turned witness; the authorities could obtain no evidence. "Everywhere," wrote a police constable, "I find myself up against a stone wall." In 1934 an official reported, "We are about as far away from doing anything really effective toward the suppression of the potlatch system as we were when actions against the Indians were started years ago." By the 1930s it was the Indian agent, not his wards, who felt frustrated and thwarted. "My position in relation to the Potlatch is becoming intolerable," wrote the Kwakiutl agent in 1936.



That year the Department of Indian Affairs put forward an amendment aimed at circumventing Kwakiutl strategies. It would have allowed agents or police to seize any property deemed excessive for an Indian's needs. The proposal ran into objections from the House of Commons, where members strongly opposed it on the grounds that it was unreasonable, unjust, and un-British. The amendment was withdrawn, and the department resigned itself to leaving the matter to the influence of church, school, and the "good sense of the Indians themselves." The potlatch had, in fact, begun to fall on hard times. Christianity was taking stronger root among the Kwakiutl, and young people were losing interest in long rituals and arranged marriages. Resources were also becoming limited: as early as the 1920s the Indians suffered from competition with white Canadian and Japanese Canadian fishing boats, and then the whole economy was devastated by the depression of the 1930s.

Although better times returned in the 1940s, the potlatch remained in decline.

Members of the younger generation were more concerned with issues of contemporary social justice: obtaining equality in pensions, veterans' benefits, and child allowances; more hospitals and better health care; the right to vote; better education; and an end to federal taxes on fishery earnings outside the reserves. In the hearings leading up to the 1951 revision of the Indian Act, the issue of the potlatch went unnoticed. Even the proposals submitted by the Native Brotherhood, led by the high-ranking Kwakiutl Bill Scow, made no mention of the prohibition.

The revised Indian Act, reflecting the parliamentary committee's recommendation that it be purged of its many "anachronisms, anomalies, contradictions and divergences," simply discarded the antipotlatch provision. A new consciousness of their heritage and rights soon arose among all Northwest Coast Indians. Within the Kwakiutl and other Indian communities there was a renaissance of artistic work, a resurgence of potlatching, and an increase in political activity, which was centered

on the issues of land and self-government.

The potlatch of the 1990s is part of that renewed pride and identity. While it differs in some ways from ceremonies of the nineteenth century, the occasions do not depart significantly from tradition. The same phases of the life cycle—birth, naming, puberty, marriage, death—are marked by feasts, dances, and gifts to witnesses. The same regard for rank and descent, the same concern for recognition of guests according to station, and the same spirit of free and unconcerned generosity prevail.

The antipotlatch law, and particularly the prosecutions and imprisonments of the 1920s, remain indelible in the memory of the Kwakiutl, symbols of persecution of their identity and way of life. But at least the masks and coppers that they had to surrender have now been returned to Alert Bay and Cape Mudge and placed in Kwakiutl museums and cultural centers, where they serve as visible evidence of the continuity of a people and of their ceremonial and artistic traditions. □



For her coming-of-age ceremony, or *ima*, Teema proudly shows off her traditional armbands, breast bands, belts, bark cloths, and woven hat. Her wristwatch and the money dangling from her lips are modern signs of wealth.

Bryan Curran

Coming of Age in the Ituri

A young girl's rite of passage is not complete without a colorful bark cloth

by David S. Wilkie and Gilda A. Morelli

Over the screams and giggles of children playing, and the pitiful yipping of a dog probably caught stealing some food, the steady percussion of an ivory mallet on a log anvil resounds through the forest. Mokomoko is hard at work, pounding a thin strip of fig tree bark into a supple swathe of clothing. As he stops to stretch his back, his wife, Aluta, comes over and hands him their toddler Chabo. With the youngster settled contentedly in his father's lap, Aluta can stoke the fires over which strings of catfish are slowly drying and is free to join the other women who are leaving on a fishing trip. Calling over her shoulder as she departs, Aluta reminds Mokomoko to prepare, for the evening meal, the last of the bananas that she brought with her to the camp.

It's the middle of February and Mokomoko's family and relatives are camped near the Angileepée River in the Ituri rain forest of northeastern Zaïre. They are Efe Pygmies, and like their ancestors, they live by hunting, trading, gathering, and fishing. For much of the year they live within a mile of the villages of their farming neighbors, the Lese. At these times, Aluta obtains the bulk of her family's food by working in Lese fields in exchange for such cultivated crops as bananas and cassava. But now, during the two-month dry season, Mokomoko and his family have moved their camp deep into the forest in search of the small rivers that yield a wealth of fish.

As the waters of the Angileepée recede, marshy pools form along the oxbow bends of this meandering river. In these backwaters, the women and girls will spend most of the day fishing. Among tree roots, beneath fallen branches, and under the riverbank lurk catfish, carp, and small crabs. Immersed in the muddy gruel, Aluta searches for them with her hands. As something brushes against her forearm,

she lunges, grabs, and is rewarded with a nasty gash in her thumb as the catfish avoids capture by lashing out with its pectoral spines. Not all catfish escape as deftly. For the next hour, Aluta adds fish after fish to her basket. When the women's catch rate begins to decline, Aluta's aunt suggests they take a break before moving to the next pond.

Laughing and joking, the women and girls rise out of the mire and head back to the river to rinse off the mud and green algae that cling to their bodies. Aluta teasingly tells one of the younger girls that she is clearly turning into a woman and no doubt will soon be running off with one or another of the eligible men in the area. To'kuta takes the gibe good-heartedly and mocks her tormentor for still nursing N'dolu, who is now three. Aluta replies, "I've tried to wean him, but he refuses, so I guess he's not ready." Everyone laughs.

Sitting near the riverbank on an improvised mat of large *Marantaceae* leaves, Aluta cuts tobacco into shreds, tamps it into a tar-blackened clay pipe, and inserts the stem into the three-foot-long, hollowed midrib of a banana leaf. Knocking an ember from a smoldering piece of firewood, she places it over the tobacco and, after drawing heavily, shudders from the quantity and potency of the smoke that she inhales. Hacking, she passes the pipe to the other women, and the resting site quickly grows hazy with tobacco smoke, which percolates slowly into the tree canopy above.

To'kuta wraps some fish in leaves, places them on the coals to cook, and then joins the other girls, who are getting more and more animated as they chatter about the upcoming ceremonial dance, or *ima*, to celebrate the coming of age of Safarani and Teema. Will it be this full moon? Who'll be there? How will we paint ourselves? Will the WaZungu ("white per-

son," in this case, the authors) give us some perfumed soap? Soon everyone is talking about the dance. This will be the first *ima* in the area for many years, and everyone is excited. Aluta starts a refrain about the last *ima*, To'kuta adds syncopated hand claps, and the rest join their voices in a complex, weaving roundelay that embellishes the buzz of cicadas and the babble of the river. The song's tempo and mode change as each woman gets the chance to add her own verse. No matter how often or abruptly the meter shifts, the chorus never stumbles. These remarkable women are part of an impromptu choir that has no need of a conductor.

As the song peters out, Aluta checks the roasting fish. Trying not to burn her fingers, she unwraps the charred leaf parcels, and the steamy aroma of baked fish provokes a few hungry stomachs to growl in anticipation. The fish is moist and delicious, and in a matter of minutes, some well-cleaned bones are all that remain. Apparently reluctant to get back to fishing, the women spend a few more minutes chatting and smoking before setting off again to the water.

It is late in the day when the women get back to camp with baskets more than half full with fish, crabs, and mushrooms, the latter gathered on the trip home. By this time Mokomoko has nearly finished pounding the bark into cloth. Probably in his midfifties, Mokomoko is one of the few Efe men in this area acknowledged for his skill in making bark cloth. He had been planning on making a bark cloth for several days but had not come across a suitable *isele*, a fig tree, until yesterday. On the way back from an unusually successful hunt, where not one, but two Gabon duikers had been captured, Mokomoko cast his eyes upward, looking for the *isele*'s characteristic leaves. The bark from a variety of trees can be used to make

Wading in the backwaters of a river, below, Efe women catch fish with their hands and stash them in wicker baskets. Right: In a field near her village, a Lese woman gathers the succulent young leaves of a cassava plant, which she will pound and boil with raw palm oil to make a dish called sombe. The Lese, who are sedentary farmers, are trading partners with the more mobile Efe foragers.

Bryan Curran



cloth, but Mokomoko believes that *isele*, although more difficult to work with, is the most durable and carries dyes the best. Just as he was about to give up and try again the next day, there, wrapped around a sixty-foot tree, was an *isele* of the right size. As the most suitable branches were about thirty feet from the ground, Mokomoko spent a few minutes deciding how best to reach them. A small machete tucked in his belt, Mokomoko climbed upward, grasping vines and the strangler fig itself for support. Using his machete, he carved two rings around a branch, about three feet apart, then connected them with a single perpendicular gash. With the edge of the blade, he carefully prized up the bark and peeled away the rectangular section he had excised. After cutting off two similar-sized pieces, he backtracked to the ground, rolled the bark into a tube, secured it with a cord improvised from the stem of a forest herb, and quickly set off to catch up with the rest of the men heading back to camp.

Bark cloth, once the most important form of clothing for the inhabitants of the Ituri, has now been largely supplanted by used Western clothes or imported cotton cloth. A few men still prefer to wear bark cloth when out foraging in the forest, and both the Efe and the neighboring Lese don these traditional clothes for dances and coming-of-age ceremonies.

Although Mokomoko actually makes the bark into cloth, it is Aluta, with her artist's eye and imagination, who transforms the beige, fibrous "canvas" into a painted and patterned bark cloth. The complexity and intricacy of Aluta's designs depend largely on the function of the finished cloth. If it is for a man to use, to preserve his more precious Western clothes while hunting, then the whole cloth is often just dyed black by being dunked in particularly unctuous swamp mud for a few days. If the cloth is to accompany a girl through the ceremony that welcomes her into the world of women, then Aluta will lavish all her skills and attention on its decoration. It is these *ima* bark cloths that epitomize Efe art. Only the ephemeral art of face and body painting can compete for this accolade.

The two cloths that Mokomoko has pounded flat, rinsed clean with water from the river, and spread out on top of his hut to dry are for his granddaughter's *ima*. Mokomoko and Aluta began caring for Safarani after her father (Mokomoko's son by his first wife) was killed three years ago when he fell out of a tree while raiding a beehive for honey. Her mother died in labor when Safarani was a toddler. She is now about fifteen years old, and since her breasts began to develop, she has been ensconced in a Lese hut with Teema, the daughter of the village chief, Ondikomvu.



Teema, like her friend, is also approaching womanhood. Mokomoko and Ondikomvu have been trading partners since they were young men; thus, when Ondikomvu proposed to celebrate his daughter's coming of age with an *ima*, it was not surprising that Safarani would be involved too.

Holding an *ima* is expensive. The girls must be fed and cared for during the months that elapse between the time they enter the *ima* hut and the time they are considered to have reached womanhood. More importantly, food and drink must be prepared for the whole community, which congregates for the dance and feast that accompanies the girls' ceremonial release. No Efe and few Lese can afford an elaborate *ima* independently, which makes



Teema's and Safarani's a rare, as well as an important, social event.

It's dark now, and the camp begins to settle down for the night. A couple of dogs squabble over some fish bits thrown onto the midden, but Aluta quiets them with a well-hurled stick. Walking back to her fire, she stops at her son Baranga's hut and asks him if he would find some of the fruit called *tato* for her tomorrow, as she must paint Safarani's bark cloths before the dance. The clear juice of the *tato* stains skin and bark cloth black. Baranga says that he remembers seeing a fruiting *tato* when he was out hunting yesterday and will go and pick some early next morning. Aluta thanks him and returns to her hut to set out the sleeping mats for her family.

Mokomoko moves the fire into the hut and, with the aid of a folded leaf, wafts it to life again. Aluta, glad for the warmth, smiles contentedly as N'dolu snuggles to her breast and nurses himself to sleep. Her husband, not satisfied with the fire, rearranges the logs, then tosses a particularly smoky section out into the dark, where it spirals red before dashing to the ground in a scatter of glowing embers.

Misjudging dawn by about an hour, the camp cockerel rends the night's relative calm. Not that it seems to matter, as the camp will not rouse itself for a while. When the sun is finally high enough to pierce through the wall of trees into camp, Aluta gets up and calls to her daughter-in-law to pack up the dried catfish for their

trip back to the road. Aluta plans to go back to Ondikomvu's village to trade the catfish for some bananas or cassava and to ask the chief's second wife, Undetobo, to lend her a piece of *ndo* heartwood used to make the red dye that so characterizes Efe bark-cloth painting. *Ndo* is not found in this part of the forest and must be brought from the traditional homelands of the Efe west of here. Both the Efe and Lese were forcibly resettled in the 1940s when the Belgians used their labor to build the roads that now traverse the forest.

Hoisting the basket onto her back, Aluta adjusts the bark tumpline across her forehead and follows the three other women heading down the trail that leads first to the river U'Komba and then to the

road. It will take nearly eight hours to reach Ondikomvu's village, so the women must move at a brisk pace. The trip to the road is punctuated by several tobacco breaks and one brief scare when men's voices are heard along the trail. "Who can they be?" whispers Aluta, as the women wait cautiously at the edge of the trail. As the men approach, one of the women recognizes the voices of Ondikomvu's sons Zetina and Batinanza. The brothers are apparently on their way to check the leg-hold snares they set last week, hoping to trap an antelope or two to augment the food supply for the upcoming *ima*. After the men pass, the women step back onto the trail and continue on their way.

About two miles before the women reach the village, the vegetation along the edges of the trail becomes much more dense, and the tall, primary-forest trees that so effectively filter the sun's glare are replaced by smaller, second-growth species. During the Belgian colonial period this area of forest was cleared for cotton cultivation but was abandoned soon after independence in 1960. Most of the Ituri is old-growth forest, but the roadsides are bordered by large patches of regrowth forest, where old plantations were deserted and where farmers must let their fields go fallow before recultivation.

Leaving the relative cool of the forest, Aluta and the other women follow the trail into Ondikomvu's new field. Heat from the scalding equatorial sun shimmers ahead of them as they search for a route through the tangle of felled timber that Ondikomvu hopes will be dry enough to burn before the onset of rains in March. Walking along a particularly large log that leads down toward the spring used as a water source, Aluta finally reaches the edge of the village. She dumps her basket inside the nearest cooking shelter and sits down to talk with Ondikomvu's wives Melika and Undetobo. While the women talk about how good the fishing is, Ondikomvu sits alone in his shelter grinding a potent mixture of local tobacco, hot red pepper, and salt into snuff. After sniffing a pinch held between his thumb and forefinger, which makes his eyes water, he bends over and scrapes the rest into



Ric MacDowell



Ric MacDowell



At left, top, one man cuts bark off a tree he has felled, while another, center and bottom, pounds bark into cloth. The old ivory-tusk mallet has grown dark from being stored in the smoky roof of a hut. Below: Using red dye made from the heartwood of the *ndo* tree, a woman fills in designs she has already drawn in black on a bark cloth.

Both photographs by Richard Wrangham; Anthro-Photo



the squirrel-skin pouch on the ground.

While Melika fetches some water for her husband, Undetobo asks Aluta not to take the *ndo* back with her to camp, as she also wants to use it to paint a cloth for her daughter Teema. Aluta agrees and, using a pear-shaped knife, starts to plane a fine dust from the red-hued plank. Pleased with the good handful of dye that has accumulated, she raps the wood with the knife a couple of times to knock off the last of the red powder before wrapping it securely in a leaf bag. For the rest of the evening, both women roll dried palm-leaf epidermis into cord that they will weave into belts, breast bands, and feathery arm straps for their girls to wear at the *ima*.

Next morning, once the dew has dried,

Aluta and the other women leave the village with baskets stacked high with garden produce. Aluta grumbles to the other Efe women that Undetobo expected more in trade than she thought fair. She says that Undetobo had complained about how the catfish she had been given the previous night were small and bony and demanded that Aluta make a bark cloth for Teema in exchange for the bananas and cassava. While the Efe women murmur in assent, back in the village Undetobo's co-wife complains that, as usual, Aluta left with more heads of bananas than the few catfish she had brought were worth.

Walking through last year's banana field, which by now has already been invaded by numerous weeds, shrubs, and

rapidly growing trees, Aluta notices a patch of *binjali*, an herb, growing close to the trail. As the roots of *binjali* produce a wonderfully vibrant yellow dye, Aluta stops to see if it is mature enough to bother collecting. Digging with a woman's small machete, Aluta clears the soil away from the roots. In a few minutes, she has extracted a small stack of wrinkled roots that look somewhat like carrots. These are carefully wrapped in leaves before being tucked into her basket. During the long hours back to camp, Aluta daydreams, now and again, about how she will decorate Safarani's and Teema's bark cloths.

While Aluta was off at the village, Baranga had found five egg-sized *tato* fruits. Borrowing another woman's knife,



Aluta cuts the fruit in half, then carefully squeezes and scrapes the juicy pulp into a bowl-shaped piece of a broken clay cooking pot. With the metal point of an arrow, she prizes off several small chunks of charcoal from a smoldering log and grinds them against the side of the bowl, forming a black slurry with the *tato* juice.

Aluta places the larger of the two bark cloths across her lap, dips a palm-wood “quill” into the dye, and begins to lay a series of thickish black lines on the fabric. As her work progresses, the lines link up into a regular pattern of nested diamonds. Although also composed of parallel lines, the shapes on the second piece are irregular and have cleverly positioned anomalies that attract and lead the eye. As soon as

both cloths are outlined in black, Aluta places them aside to dry. Swirling the *tato* slurry that remains at the bottom of the bowl, Aluta calls her niece to come and have her face painted. With a new, much thinner palm splinter, she draws a fine line down Keniteefo’s forehead and along the ridge of her nose. The designs Aluta paints on Keniteefo’s face are more intricate and varied than those on the two bark cloths. Maybe the fabric’s coarse texture precludes the more delicate designs of body painting. While Aluta continues to work on her niece, Maratsi, a young girl, splays a segment of palm into a four-pronged pen and, after dipping it into the dye, daubs a speckled necklace across her chest. Soon it seems that half the people in the camp

are painting themselves or one another.

Aluta gets up to stretch her legs, folds a leaf into a cone, and dips some drinking water from a large aluminum pot stored in her hut. Tossing the disposable cup onto the ground, she hauls the bark cloths off the roof to test if they are dry. Happy with the results, she settles back among the last of the face painters and begins to mix the red wood powder and a little palm oil into a loose paste. While Aluta works on the dye, her sister Okalese sits beside her and empties the *binjali* from the basket. After scraping the outer skin from the yellowish roots, she places them in a small wooden mortar and pounds them into pulp, adding some water now and again to loosen the consistency. Using her fingers as a palette



Many of them shivering in the early morning cool, young girls, left, wait their turn to be bathed in the river, signifying the start of the ima celebration. Below: Decorations for the ima dance can be as simple and flamboyant as strategically tied leaves. White clay or a dusting of borrowed talcum powder add to the effect.

Richard Wrangham; Anthro-Photo



knife, Aluta spreads the dyes onto the outlined cloth. Once in a while Okalese leans over her sister's work and suggests where to paint next.

By the end of the day, Aluta's mastery of her craft shows in the beautifully colored and patterned bark cloths now ready for the *ima*. For the next few nights, the girls in the camp watch as the moon grows ever more round, knowing that soon it will be time to return to the road to prepare for the ceremony and feast.

It's still several hours before dawn, but Ondikomvu's village is anything but quiet. All the huts are abuzz with friends and relatives chatting, exchanging news, and gossiping. The big, new meeting hut, hastily erected over the last two days, is alive

Safarani and Teema are carried to the village center, where they will be the focus of several days of festivities.

David S. Wilkie and Gilda A. Morelli

with the sound of dancing, drumming, singing, and clapping. Safarani and Teema have been awake all night, learning the traditional *ima* dance steps from the older women of the village. In a few minutes they will be spirited from the hut and carried down to the river to be washed alongside all the younger girls. Undetobo has been keeping a precious block of soap for the occasion. She proudly hands it to Aluta, who briefly dunks Safarani in the water, then lathers her hair and skin. In the predawn chill, many of the girls shiver as they wait their turn with the soap. After the last one is washed, Teema is lifted out of the water and carried back to the hut with Safarani. Aluta and Undetobo hurry ahead of the procession. Inside the hut, Aluta checks the bark cloths, the belts, and the arm straps that have been made for Safarani and Teema. Undetobo uncorks a bottle of palm oil, with which she anoints the girls.

The sun rises higher above the horizon, and the excitement mounts as the crowd waits outside for the girls to appear. Ondikomvu gives Undetobo a hat of strawlike material that he has just decorated with the crimson tail feathers of a gray parrot. Teema gleefully places it on her head. At last, the door opens and Teema and Safarani, carried aloft in chairs, soar among the crowd. The eyes of all the young men are focused on the two young women, whose bodies gleam provocatively in the sun. The mood of celebration is infectious; soon everyone is singing and dancing with the procession as it winds toward the center of the village.

For the next three days, the village vibrates with the nearly constant clamor of the festival. Teema and Safarani are the focus of more attention than they have ever had, and both are making the most of it. But as the supplies of food and palm wine dwindle, so eventually does the energy of the dancers, who will probably disperse on the morning of the fourth day.

Sitting at the edge of a cooking shelter, having a quiet smoke with Undetobo, Aluta smiles as she watches Teema and Safarani and wonders when she and her husband will next have occasion to make and paint bark cloths for an *ima*. □





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Why Jellyfish Stick Together

Caribbean thimble jellies travel in the same circles

by Ron Larson

I am lying on the "ceiling of the bay," as naturalist William Beebe called it. Below me is a turquoise blue, aqueous world filled with thousands of living brown "thimbles." They gyrate and orbit and seem to pulse rapidly. When I reach down and touch one, it shoots hundreds of microscopic projectiles into my skin, which tingles from their injected toxin.

I have come to this Belize barrier reef to witness the swarming of the jellyfish *Linuche unguiculata*, known throughout the Caribbean as the sea thimble. A small, bell-shaped invertebrate, it is about the size of a quarter in diameter, one-half that in height, and conspicuously dappled with chocolate brown markings—concentrations of symbiotic algae. Unlike many other jellyfish, thimbles do not sport scores of stinging tentacles, yards in length. Instead, they have only eight threadlike tentacles about one-eighth of an inch long. Their nematocysts, or stinging cells, which release microscopic poison darts when touched, are sprinkled over the exterior of the bell and the tentacles.

Unlike the sting of the Portuguese man-of-war, which is immediately and intensely painful to humans, the thimble's sting does not produce an immediate burning sensation. There may be a mild tingling, and many people feel little or nothing for several days. However, while some individuals are immune to aftereffects, others later develop red welts that itch and burn. Fortunately, I never suffer from thimble attacks.

In 1920 William Beebe described thimble jellyfish swarms in his book *Beneath Tropic Seas*. He first saw them off the coast of Haiti on an Easter Sunday:

For two full miles of our course the sea was filled with vibrating thimbles—jellyfish of exactly the size and shape of these homely articles, close to the surface, fairly bumping against the ceiling of the bay. Sometimes they were swimming a foot apart, and again for hundreds of yards they were pressed against one another. . . . In a square foot of surface I counted seventy-four. . . . I dipped up a hundred in a single scoop of the net. . . . A pailful of water contained three solid quarts.

About 100 years earlier, when traveler-



The Caribbean

A mature thimble jellyfish, shown about eighty times its actual size, appears mottled because its pouches are filled with dark, symbiotic algae. Thousands of nematocysts, or stinging cells, dot the bell's surface, while tiny tentacles protrude at the bottom.

Ron Larson



Swarms of thimble jellyfish swim upward, always staying near the sea's surface. A diver moving through them risks dozens of itchy, burning stings.

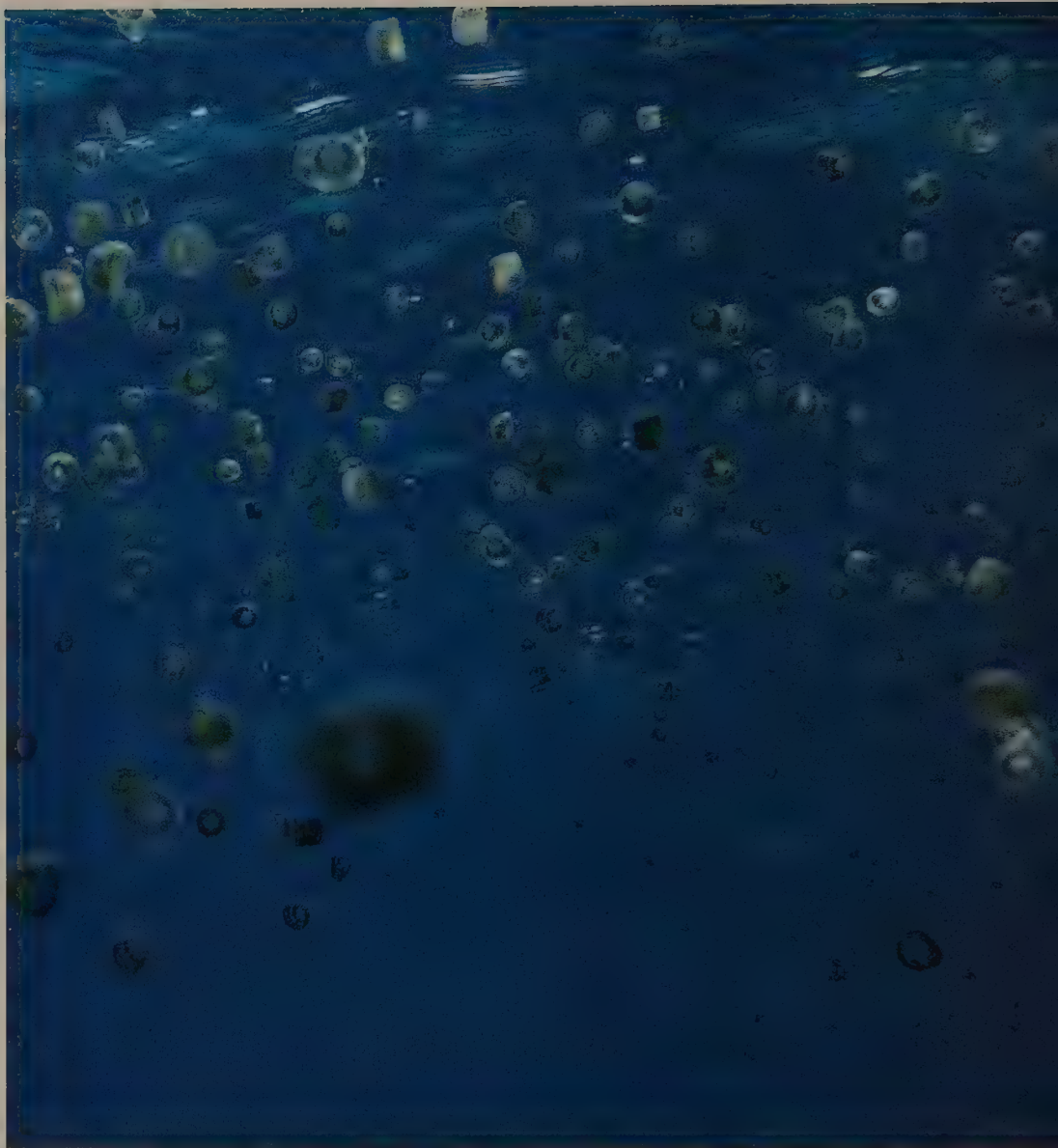
Philippe Willenz

writer Orlando Roberts sailed along the Caribbean coast of Nicaragua, he described the sea as being covered with thimble-shaped "blubber fish" and observed that they formed the principal food of the local green turtles. Later, American biologist Walter Fewkes described passing through aggregations of the little thimbles at the Dry Tortugas, west of Key West, Florida, "reaching as far as the eye could follow."

Although I have come across many such anecdotal accounts, as far as I know no one before me had actually studied these thimble jellyfish swarms, which appear in tropical oceans for only a few months each year. As an avid cnidariophile, or lover of the phylum that includes sea fans, anemones, hydras, corals, and jellyfishes, I have pursued related organisms, for the past twenty years, from the Arctic to the Antarctic. Somehow, the little thimbles had eluded me, but my curiosity about accounts of their dense concentrations eventually made me seek them out.

I saw my first thimbles in a dusty bottle of Formalin on a dimly lit shelf in the Smithsonian Institution. Of course, the pale, lifeless blobs bore little resemblance to the animated, pulsating bells described by Beebe and others. Later, in Puerto Rico, a fellow graduate student brought in a pailful of thimble larvae. Known as ephyrae, these tiny, flattened jellyfish larvae resembled brown wheels; looking at them under a microscope, I saw that their color came from hundreds of tiny spherical zooxanthellae—symbiotic, one-celled algae that also live in coral animals and many other tropical cnidarians.

It was not until many years later, when I was investigating jellyfish at the Smithsonian's Carrie Bow Cay Marine Laboratory on the barrier reef in Belize, that I finally saw a full-fledged swarm of thimbles. At first, it looked like an oil slick: a glossy, dark brown ribbon winding hundreds of yards through a choppy, milky blue sea. Navigating toward the swarm in my inflatable boat, I could see that the water was peppered with small objects. Exactly as Beebe had described, each square foot contained nearly 100 thim-



bles, each swimming to its own beat, yet somehow staying with the swarm. Over the next several years, I would spend spring vacation on the tiny coral island of Carrie Bow Cay, trying to understand the origins and dynamics of thimble jellyfish swarms.

In general, the jellyfish that most of us are familiar with are adult males and females, known as medusae—the sexual stage of a life cycle that begins with two larval stages. First, the fertilized egg develops into a microscopic creature that is propelled by its cilia and eventually attaches to a surface near the sea floor. There it transforms into a polyp that will produce many wheel-like ephyrae, about 1/25 of an inch across; like a perennial plant, it will continue to produce them each spring. These ephyrae rise to the sea's surface, where they drift with the currents among the plankton, eventually growing and transforming into the familiar medusae with their writhing tentacles, named for Medusa, the mythological Gorgon whose tresses had been turned into snakes.

The polyp of the thimble jellyfish was undetected until University of Puerto Rico student Edgardo Ortiz-Corps, along

with my former professor Chuck Cutress and his wife, Bert, published a paper in 1987 describing its complete life history. Unlike the polyps of many related creatures, the thimble's polyp lives in a horn-shaped chitinous tube about a quarter of an inch long; it resembles the fossil tubes of an ancient Cambrian group of invertebrates that may well be its ancestors. From dredged samples, these unusual tube-dwelling polyps were raised in a laboratory aquarium, where they produced ephyrae, which matured into adults.

Adult thimbles begin to grow and mature in early spring, and for the next three to four months, masses of them drift among the coral reefs and sea grass beds, swimming at the surface, where their symbiotic algae can be exposed to sunlight. Pat Kremer, a jellyfish specialist at the University of Southern California, has established that these algae, which are particularly numerous in thimble jellyfish, produce much of the energy required by the thimble, even though it also feeds on zooplankton (microscopic animals). After about two months, the nearly mature thimbles are dime-sized and their chocolate brown swarms are conspicuous.

Thimbles are not the only jellyfish that

The Caribbean

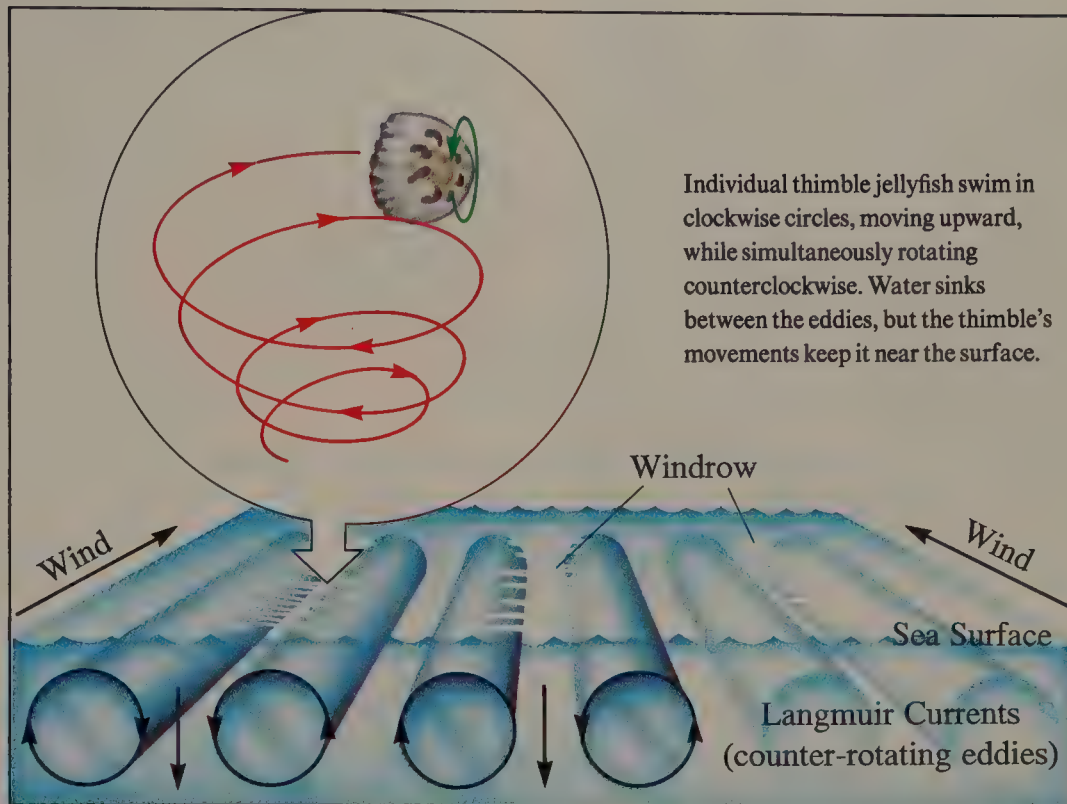
Thimble jellyfish aggregate in swarms when Langmuir currents herd thousands of individuals into long, parallel formations called windrows. Fairly uniform spacing between these blind organisms is maintained by their circular swimming pattern. (The diagram is not to scale: windrows may be more than 300 feet long and up to 10 feet wide, while individual thimbles are about the size of a quarter.)

Joe LeMonnier

aggregate. Throngs of other species are often swept into eddies or tides. Thimbles, however, are almost always seen in dense patches no matter how still the water. After spending hundreds of hours combing the shallow inshore waters along the Belize reef, I found only a few strays and these were usually located near a large aggregation. Furthermore, whenever I dipped plankton nets near the barrier reef, I rarely collected any isolated thimbles. But how do such weak swimmers remain in clusters for up to five months? Surely tides and winds should disperse them. To answer this question, I studied the swarms to see how their shapes and sizes varied under different conditions.

Over a three-year period, during which I studied twenty swarms, I found that wind patterns seemed to account for variations in both shape and density of the aggregations. During calms, thimble jellyfish were most often seen in poorly defined patches where their density was low (approximately one per square yard). However, when winds were moderate, they appeared in formations, known as windrows, more than 300 feet long, which were sometimes so dense that individuals often touched one another—the situation described by Beebe and others.

Windrows—long formations of floating objects shaped by winds and currents—are well known to sailors and oceanographers and are common in both oceans and lakes. In 1927, American physicist Irving Langmuir noted during a transatlantic cruise that sargassum weed tended to accumulate in windrows. He further noted that when the wind changed direction, these long lines reoriented themselves parallel to the wind. Later, he experimentally determined that wind blowing over open water produced counter-rotating horizontal eddies and that flotsam (floating seaweeds, debris, plankton, and even oil films) accumulated in convergences where adjacent eddies forced the water down. These Langmuir currents rotate in opposite directions; in between them, where the water “sinks,” passive accumulations of floating objects are “corralled.” While Langmuir currents seem to be dependent on wind speed, water strati-



fication, and depth, precisely how these interact to form the familiar patterns is still unknown. However, their effects are unmistakable. In the Caribbean, where northeast trade winds are strong, an airplane passenger can easily spot the long, parallel brown lines of sargassum or even of thimbles from a great distance.

I had noticed early in my studies that thimble windrows are usually associated with floating objects such as algae, sea grass blades, and discarded plastic debris. What I didn't know was how the thimbles accumulate in the windrows since they do not float. It seemed plausible that upward swimming by thimbles in convergence zones could be largely responsible for the aggregations and might play a major role in shaping the swarms. I was indeed able to observe some thimbles swimming upward, but they also swam in other directions, mostly horizontally.

However, I found that the swarms stayed together even during windless periods (although they were less dense). Off Belize in spring, the wind is calm about 10 percent of the time, and the trade winds there may not blow for several days in a row. If the Langmuir currents were solely responsible for thimble aggregations, then

during calm periods thimbles would certainly swim or drift apart.

I wondered if these jellyfish swarms had characteristic patterns of swimming that could be keeping them together. Other, more complex invertebrates, such as squid and shrimp, can school like fish. Was it possible that “primitive” jellyfish, with brains the size of pinheads and lacking eyes, could actively school, too? Perhaps thimbles use a simple, stereotyped swimming pattern that functions to maintain uniform distances between individuals in a swarm. To answer this question, I observed their movements closely as they swam in the sea and made videotapes of them in a small pool.

While snorkeling among a swarm near Carrie Bow Cay, I discovered that thimbles do have a characteristic swimming pattern: they move clockwise in circles about three feet in diameter or less. This simple repetitive movement helps stabilize the swarm; once gathered by currents, they are less likely to veer off in all directions and disperse. (My captive thimbles were less cooperative in the pool, with many swimming to the bottom, but they also swam in clockwise paths.) Strangely, upon closer examination in an aquarium, I

Lacking eyes and extended tentacles, a thimble jellyfish viewed from below, right, reveals its symmetrical, hollow umbrella shape. Below: An arrow crab, one of the thimble's few known predators, grabs a meal.

Ron Larson



found that individuals spun counterclockwise like propellers, even as they swam in their clockwise circles.

I now had good reason to believe that thimble jellyfish swarms were the result of more than just wind and water acting upon passive organisms. But what advantage would they gain from actively swarming? Animals usually aggregate in order to escape predators, to feed, to reproduce, or to make social contact. When fishes and some shrimps school, they gain from the safety of numbers: predators find it more difficult to single out individuals for attack. Schooling, however, calls for highly coordinated group movements in which distances between individuals remain constant, an impossible feat for the thimble jellyfish's relatively simple nervous and locomotor systems.

But clusters of thimbles probably would attract predators. In the very recent past, before they were decimated during the last fifty years, marine turtles probably followed thimble swarms for miles and gorged on them. In addition to turtles and a few species of fish, the arrow crab is known to prey upon thimbles, which it catches when swarms come near mangrove roots. What possible advantages

could have accounted for the evolution of swarming during eons of vulnerability to predation?

Better opportunities for obtaining food may be one, since the thimbles probably find greater densities of their own prey swept into Langmuir-caused windrows, where many planktonic animals become concentrated. On the other hand, because thimbles derive much of their food from their resident algae, increased prey densities may not have been sufficient to offset the dangers of swarming.

I believe a major reason that thimble jellyfish swarm is to enhance their chances of reproductive success. Unlike terrestrial animals, most marine creatures simply release their gametes into the sea, subjecting them to dilution and dispersal. Without some means of focusing on their targets, the sperm die in the open ocean without ever contacting unfertilized eggs. By concentrating their population within a limited area, thimble jellyfish can vastly improve their fertilization rates.

Some invertebrates overcome the problem of sperm dilution by assembling only when they are ready to reproduce. For example, many marine worms come to the surface and spawn in phase with the moon. At Carrie Bow, large numbers of bioluminescent worms swim out of the reef just after dark, in response to a lunar cycle. At the surface, they burst open, releasing glowing clouds of gametes. Although the life of the individual animal ends, it has greatly increased its chances of leaving offspring. Similarly, corals and other relatively immobile invertebrates along the Great Barrier Reef of Australia also spawn synchronously, using lunar and temperature cues.

Thimble jellyfish have evolved their own strategy to avert sperm dilution. Mature thimbles spawn daily for a month or more and must therefore remain quite near one another for effective reproduction. By aggregating throughout their entire adult lives of about four to five months, using Langmuir currents to help keep them together, and swimming in tight little circles, the sightless, virtually brainless thimble jellyfish have managed to survive through the ages. □



The Caribbean

America's Ancient Mariners

The Maya displayed a flair for seagoing trade

by Anthony P. Andrews

The first Maya the Spaniards encountered, during Columbus's fourth voyage in 1502, were a group of merchants near the Bay Islands, off the coast of Honduras:

There arrived a canoe full of Indians, as long as a galley and eight feet wide. It was loaded with merchandise from the west, almost certainly from the land of Yucatán. . . . There was in the middle of the canoe a shelter of palm matting. . . . Inside and under this were their women and children, possessions and merchandise, so that neither rain nor sea water could wet anything. . . . There were in the canoe up to twenty-five men. . . . They had in it much clothing of the kind they weave of cotton in this land, such as cloth woven with many designs and colors . . . ; knives of flint, swords of very strong wood . . . and foodstuffs of the country [Bartolomé de las Casas, *Historia de las Indias*].

At the time the Europeans arrived, coastal seafaring with paddled canoes was widespread throughout the Americas, from the Northwest Coast, with its sea-mammal hunts and war expeditions, to the Caribbean islands, where the ancestors of the Taíno and Carib Indians had easily traversed the 1,700-mile-long archipelago in large oceangoing canoes and their descendants had continued a vigorous interisland trade into the contact period. The Inca had large rafts of balsa wood, probably equipped with sails, that reached as far as the Galápagos. But the civilization most involved in extensive seagoing trade was that of the Maya.

Historical accounts report that the Maya carved large dugout canoes, from mahogany and other hardwoods, capable of carrying forty or fifty people. Most Maya seafarers hugged the coast, using landmarks, shrines, and lookout towers as navigational aids. These were particularly important in the Caribbean, with its treacherous shoreline reefs. Still, some navigators ventured out into the open sea to reach such offshore islands as Contoy, Mujeres, Cozumel, the Belize cays, and

the Bay Islands. Archeological research shows that the Maya settled Cozumel and several of the Belize cays at least 2,000 years ago; by the late Classic period (A.D. 600–900), they were traveling out to Turneffe Island, some eighteen miles off the Belize mainland.

As Maya civilization developed, many seaside villages evolved into bustling towns and trading ports. Some served as outposts of large inland communities, which sought access to marine resources and to the trading vessels that plied the coasts. Others flourished owing to their location along major trade routes and became major commercial enclaves in their own right. One of the earliest and most prominent of these was the large town of Cerros, on Chetumal Bay in northern Belize, which dates from the late Preclassic (300 B.C.–A.D. 300).

Sitting at the mouth of the New and Hondo rivers, Cerros connected the coastal trade networks of the Caribbean with inland communities of the southern Maya lowlands. From these two rivers, overland trade could reach large centers in northern Guatemala, such as El Mira-

This is the seventh in a series of articles that explore recent findings and interpretations concerning the rise and fall of ancient Maya civilization.

dor, Rio Azul, and Tikal. Other prominent early coastal communities appeared around the shores of the Laguna de Términos, on the southern Campeche coast, along the salt beds of the northern coast of Yucatán, and on the shores and islands of the Caribbean coast of Quintana Roo and Belize. The Pacific coast of Chiapas and Guatemala also saw the emergence of several town-size communities, all actively involved in the exploitation of coastal resources and trade.

Many Maya ports consisted of natural harbors on islands, such as Mujeres and

Cozumel, and in the reef-protected bays, rocky inlets, and large lagoons of the Caribbean coast. The Maya also constructed port facilities at several locations. The island of Cerritos, off the northern coast of the Yucatán Peninsula, is ringed by the ruins of docks and piers, while on its south shore a sea wall more than 1,000 feet long encloses an artificial harbor that once offered refuge to large numbers of canoes. The remains of a small administrative outpost and the residences of what were probably elite coastal traders have also been discovered. An artificial canal connects the large inland lakeside port of Muyil, or Chunyaxché, in Quintana Roo, to another lagoon that was linked to the sea through estuarine canals and lagoons.

The resources of the sea were a critical component in the emergence of Maya civilization, offering a broad array of marine and estuarine fish and shellfish, turtles, crocodiles, birds, manatees, and seals. Shells provided raw material for tools and jewelry, and shark teeth and stingray spines played an important role in Maya rituals. The great salt flats of the northern Yucatán Peninsula and the saline estuaries of the Pacific provided salt, which the Maya began to collect more than 2,300 years ago.

From early on, the coastal folk traded their food resources with communities in the nearby interior in exchange for agricultural produce and other products. Salt, shells, shark teeth, and stingray spines traveled farther, to inland communities hundreds of miles from the coast. For example, shells from both the Pacific and Caribbean have been recovered in ritual caches at Tikal. Salt was in demand to meet the daily nutritional requirements of a predominantly agricultural population subsisting on a low-sodium diet (a modern Maya farmer consumes about three-tenths of an ounce of salt per day). Salt was also used as a preservative for curing fish and meat, as a form of currency, and

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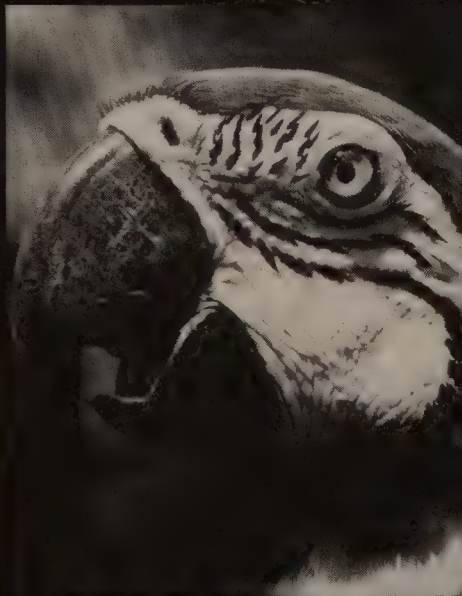
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in a variety of medicinal and ritual practices. Thousands of tons were shipped each year from the salt beds of the northern Yucatán Peninsula to communities throughout the lowlands, and from the Pacific estuaries to localities in the highlands.

The maritime trade network girded the coastline from Mexico to Panama and reached inland through every navigable river. Two major river systems flowed down from the Guatemalan highlands: the Usumacinta, which entered the Gulf of Mexico, and the Motagua, which was a major conduit to the Caribbean. None of the rivers pouring out of the highlands into the Pacific were navigable, restricting boat travel inland. Nonetheless, most of the Pacific coast from Oaxaca to Guatemala could be negotiated by inner waterways that weaved through linked estuary systems, avoiding the pounding surf of the open ocean.

Much of the Maya trade involved ex-

change of lowland and highland resources. Salt, cotton, cacao (chocolate), spices, feathers, and jaguar pelts were traded from tropical lowland regions to the highlands of Guatemala and Mexico in exchange for obsidian, basalt, jade, and other highland products. Mineral trace analyses of artifacts have enabled archeologists to pinpoint the source of several goods and reconstruct the volume and direction of their trade through time. For example, individual blades, knives, arrowheads, and ritual artifacts manufactured from obsidian, or volcanic glass, can be matched with specific volcanic outcrops in the highlands.

Communities in the Maya lowlands imported vast quantities of obsidian from the highlands, which reached them overland and down rivers and flowed into the coastal trade networks of the Gulf and Caribbean. At intervals along the coast, the obsidian passed through key trading junctures, where it was diverted inland or

The Caribbean

transshipped farther. Two such junctures were Wild Cane Cay and Moho Cay on the Belize coast, where archeologists have found large quantities of obsidian blades and prepared cores from which blades could be struck. Much of this obsidian traveled to the northern Yucatán Peninsula, some 500 miles from its origin. Some came from even more distant sources in the highlands of central Mexico, more than 900 miles away.

After A.D. 800, as many of the great Maya cities of the southern lowlands went into decline, newly emerging cities in the northern lowlands forged new trading ties to central Mexico and Central America. At the capital of Chichén Itzá, in the northern Yucatán Peninsula, archeologists have recovered large quantities of jade and ceramics from the Guatemalan highlands, turquoise from northern Mexico, and gold from Costa Rica and Panama. Many of these goods arrived by sea from the Gulf of Mexico and the Caribbean through the major trading port at Cerritos, sixty miles away. Recent excavations at this small island, which I undertook with several Mexican colleagues, have yielded all these types of trade goods, as well as central Mexican and Guatemalan obsidian. The excavations showed that Cerritos was controlled by the capital, which also controlled the nearby salt beds, the largest in Middle America.

A trading expedition departing from northern Yucatán might have included several canoes loaded with salt, cotton, honey, spices, and slaves (some of the slaves were themselves traded, while others were kept as bearers and paddlers). It would proceed south along the Caribbean coast to trading enclaves in Chetumal Bay, farther along the Belize coast, or beyond. At each stop, goods and slaves would be exchanged for a variety of articles, such as cacao (which also served as a form of currency), obsidian cores for making blades, basalt *metates* (grinding stones), jade artifacts, and occasionally gold or copper objects from farther south in Central America. Traders moving south along the gulf coast would carry similar goods and return with obsidian and basalt from the highlands of Mexico and Guatemala and fine paste ceramics and cacao from Guatemala and Tabasco.

As trading flourished during the Postclassic period (900–1520), cities throughout Mesoamerica were drawn into an increasingly “international” world, with goods and ideas flowing freely over very large distances. We know from historic

records that much of the long-distance trade of the Maya at the time of the conquest was controlled by wealthy nobles. Marriage ties were forged between the elites of widely separated cities, and long-distance merchants took on added responsibilities, acting as couriers, diplomats, and spies. Artisans and artists also traveled extensively: Postclassic Mexican sculpture and mural paintings have been found at Chichén Itzá and at the coastal cities of Tulum-Tancah and Santa Rita on the Caribbean coast. Aztec traders reached the Gulf of Mexico and down the Pacific coast to Guatemala, and possibly as far as Panama.

Shortly after the Spanish conquest, the

Maya coastal trade system collapsed. The Spaniards took over the northern Yucatán salt and cotton cloth industries, as well as many of the cacao groves and gold mines to the south. The demand for many traditional trade goods declined, as metal tools supplanted those of obsidian and flint, Spanish ceramics gradually replaced native wares, and cacao was slowly phased out as a form of currency. Moreover, the disappearance of the Maya rulers and priests undermined the demand for elite goods such as jade, turquoise, and gold. While small-scale coastal trade, mostly of foodstuffs, cacao, and salt, continued into colonial times, the large networks of the past faded from memory. □

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The Caribbean

Epiphytes of El Yunque, Puerto Rico

by Robert H. Mohlenbrock

This year the United States Forest Service is commemorating the 100th anniversary of the birth of the national forest system, for on March 30, 1891, President Benjamin Harrison created the Yellowstone Timber Land Reserve, later divided into the Shoshone and Teton national forests. Today there are 156 national forests, spread over forty-three states and Puerto Rico. Their 275,000 square miles include nearly every North American forest type, as well as prairies, savannas, bogs, sandy beaches that front both the Atlantic and Pacific oceans, and even a tidal estuary. But only one, the Caribbean National Forest in eastern Puerto Rico, contains a tropical rain forest, El Yunque. And although it became a U. S. national forest in 1903, the Caribbean National Forest region was actually set aside as a preserve by the Spanish Crown well before, in 1860.

El Yunque rain forest occupies about forty-seven square miles in the rugged Luquillo Mountains, noted for their lush plant life and fast-flowing streams. Rain falls nearly every day, particularly on the highest mountains. At the lowest elevation is the lower montane rain forest, a dense growth of tabanucos and other 100-foot-tall trees. Above this is the upper montane rain forest, dominated by huge palo Colorado trees. On the steepest slopes is the palm forest, consisting almost exclusively of sierra palm trees. Finally, on the summits of the highest mountains, enshrouded by mist and clouds, is the elfin forest, where stunted trees grow in dense, nearly impenetrable stands (see "This Land," February and December 1987).

Because the trees in the rain forest grow so thickly, permitting little sunlight to reach the forest floor, ferns and flowering plants are usually unable to survive beneath them. Instead, some of these plants find refuge in the upper canopy, closer to

the source of light, where they live as epiphytes—plants that grow on other plants while producing their own food by photosynthesis. Epiphytes are a diverse category that also includes various algae, lichens, liverworts, and mosses, plants that lack specialized vascular tissues. But of the nearly 250,000 kinds of vascular plants in the world, roughly one in ten are epiphytes, including both ferns and flowering plants. Only one large group of vascular plants, the gymnosperms (cone-bearing plants), are not represented among the epiphytes.

Epiphytic ferns and flowering plants grow most vigorously in the tropics, where rain, spray from waterfalls, or dew provides continuous moisture (only one, the resurrection fern, is commonly found in temperate North America). They differ from vines and lianas, which remain rooted in the soil as they climb trees. They also differ from parasites, such as dodder and mistletoe, which penetrate the host to obtain needed water and nutrients. The only burdens an epiphyte places on its host are competition for sunlight and possibly mechanical stress (in some tropical countries, epiphytes are routinely weeded off their hosts in parks and gardens to keep tree branches from breaking).

Some epiphytic ferns and flowering plants cannot live without a host plant in nature; others are able to live either on hosts or in the soil. The bark of a prospective host tree plays a major role in determining whether epiphytes will use the tree as a perch. Rough, spongy bark that retains water provides the spores of ferns and seeds of flowering plants a better opportunity to germinate and survive. Smooth bark, on the other hand, dries out quickly and discourages germination. Some trees even produce chemicals that keep the bark free of epiphytes.



Thomas R. Fletcher



Ray Pfortner; Peter Arnold, Inc.

Pineapplelike bromeliads, above, are among the most conspicuous epiphytic plants in Puerto Rico's rain forest, but many other epiphytes blanket the trunks of palms, far left. Left: El Yunque is the highest peak in the Luquillo mountain range.



Ray Pfortner; Peter Arnold, Inc.

The Caribbean

Since epiphytic ferns and flowering plants do not have roots in the soil, they are always in danger of desiccation, especially when exposed to the tropical sun. To counter this, in some epiphytes the stomata—the tiny openings in the leaves—open only in the evening to admit the carbon dioxide needed for photosynthesis. The carbon dioxide is stored chemically and then used in the daytime. This same metabolic trick is found in certain desert plants.

Three major groups of vascular plants—ferns, orchids, and bromeliads—include epiphytes. Many epiphytic ferns, such as the bird's-nest fern, form a nest of broad leaves clustered together on a very short, unrecognizable stem. Dead leaves and other organic material fall into the nest and decompose, while hundreds of roots grow from the stem into the accumulated organic matter. The mass of humus and fern roots acts as a sponge that soaks up and stores rainwater. The rotting material also provides nutrients. In some epiphytic ferns that do not form leaf nests, the leaves curl up and become almost brittle during a prolonged drought, only to revive quickly when moisture once again becomes available. As its name suggests,

El Yunque

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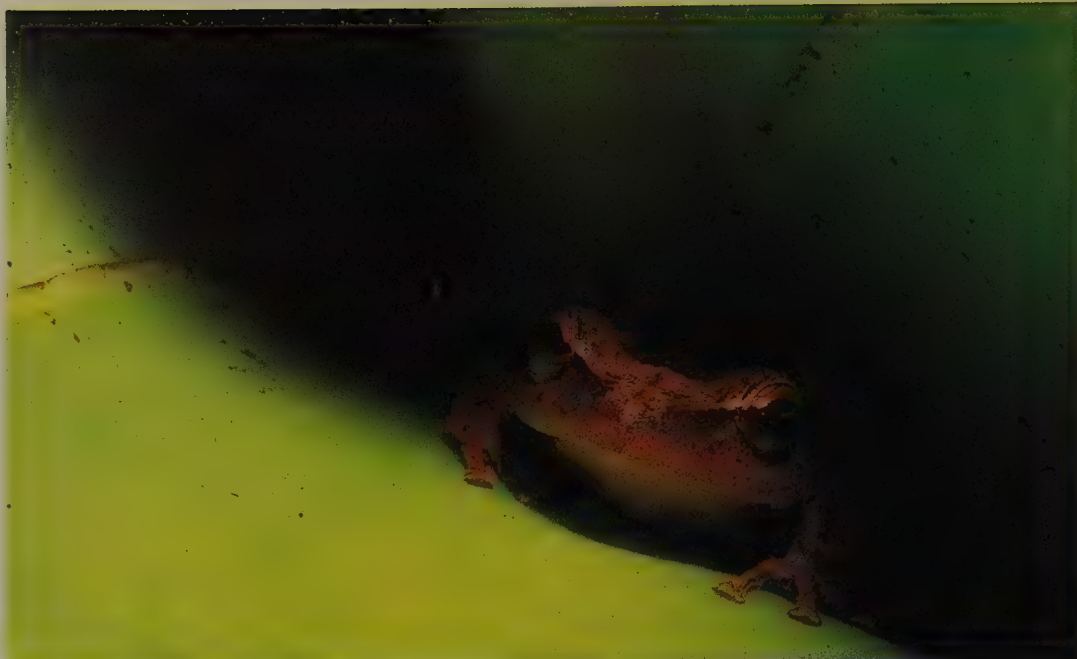
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A coquí, a frog species native to Puerto Rico, crouches in a bromeliad.

Thomas R. Fletcher

the resurrection fern has this capability.

Most orchids that live in the tropics are epiphytes, in contrast to temperate orchids, which are all terrestrial. Epiphytic orchids have water-storing tissues in their succulent leaves or bulbous stems, while their aerial roots are surrounded by a spongy tissue of dead cells that not only absorbs and retains water but also helps prevent the living cells from losing water to the atmosphere. When drought becomes severe, a cell layer at the base of each leaf allows most orchids to shed their leaves to prevent further water loss. Both the water storage tissues and the root tips contain chlorophyll, enhancing the orchid's ability to carry out photosynthesis.

A third major group of epiphytes are bromeliads, or members of the pineapple family. The aerial roots of epiphytic bromeliads do not absorb water; they merely secure the plant to its host. The

leaves, with expanded bases, are arranged in a dense, circular cluster, reminiscent of the nest of fern leaves but called a tank. The tank collects rainwater and falling organic matter. Special scales or hairs that cover all or part of each leaf surface take up water and nutrients from the tank for distribution throughout the plant.

Epiphytic bromeliads are particularly abundant in the elfin forests on the highest peaks of the Caribbean National Forest. Among them are the shiny red guzmania and the showy vriesia, species frequently imported by florists in the north to tempt their temperate clients.

"This Land" explores the biological and geological highlights of the 156 U. S. national forests. Robert H. Mohlenbrock is Visiting Distinguished Professor of Plant Biology at Southern Illinois University at Carbondale.



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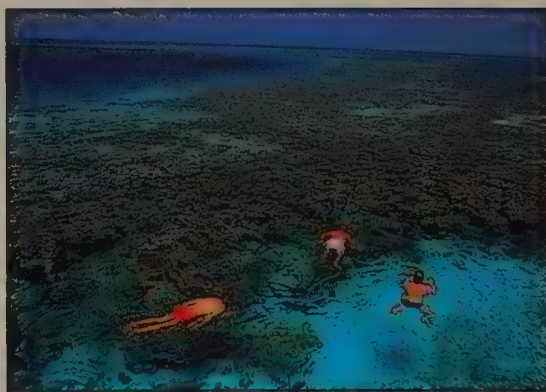
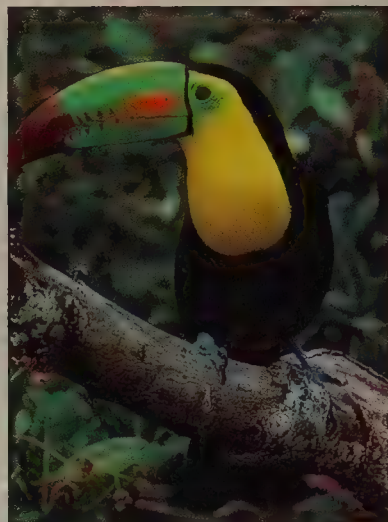
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The Caribbean

Miami's Caribbean Boom

The city's luxury restaurants are successfully exploiting Hispanic and African traditions

by Raymond Sokolov

At the corner of Seventeenth Street and Seventeenth Avenue in Miami is a laundromat called Los Tios, Spanish for "the uncles." I did not go there to wash my clothes, but to sample the unselfconscious and utterly authentic food at the little Cuban snack bar that operates next door under the same name and roof.

Real, unvarnished Cuban food is not difficult to find in Miami, but increasingly it has to be sorted out from other local variations, both plain and fancy, on Latino cooking. In recent years, Spanish speakers from other regions of the Caribbean, including the Caribbean littoral of Central America and northern South America, have followed in the footsteps of the many thousands of refugees from Cuba who have been transforming Miami into a Hispanic haven since the rise of Fidel Castro in 1959.

One can no longer assume that restaurants and markets with Spanish menus and signs are Cuban. Even on Eighth Street, where the Cuban preponderance has been so complete for so long that everyone in Miami calls the street by its Spanish name, Calle Ocho, there are Nicaraguan restaurants. At the edge of posh Coral Gables, I stumbled upon a Costa Rican lunch counter, and all over Greater Miami, as you have no doubt read several times before, there is a sudden outbreak of nouvelle cuisine Caribbean restaurants causing a sensation with glamorized versions of traditional Hispanic food.

The food heritage now being so successfully exploited by these luxury restaurants has been available in more humble, but radically more authentic, settings for a quarter-century in Miami. So while I was only too glad to taste the chic innovations concocted by chefs such as Michael Wayne Carr-Turnbough of Cafe Tu Tu

Tango in the suburb of Coconut Grove (*Brandade de morue* [the traditional French salt cod purée] with johnnycakes, *boniato* [the elegant white sweet potato], and plantain chips) or Allen Susser of Chef Allen's in North Miami Beach (plantain timbale with wild mushrooms), I did wish there was some solid middle ground between this sophisticated new world and Miami's modest, inward-looking, traditional Cuban restaurants.

Victor's Café, the well-known New York establishment, has a Miami branch

that does occupy this position, but for the most part, the Miami Caribbean boom struck me as an interesting mishmash created mostly by outsiders for outsiders. This is not necessarily a bad thing, but it is often a recipe for cross-cultural indigestion, when the clever gastronomic variations on tradition misfire because the restaurant's guests know so little about the traditions being so wittily alluded to.

This is, in the most delicious way, the case at the best and best-known of the new Miami restaurants, Yuca. The press accounts of Yuca almost invariably stumble over the place's name. It is the Spanish word for that South American root vegetable also known as manioc, cassava, *Manihot esculenta*, and in one of its processed forms, tapioca. New Yorkers who emerge from their apartments in a waking state and drug free should long ago have tripped over this staple of tropical gastronomy in their corner supermarkets, where it is sold as yuca to millions of avid local consumers. But in almost every one of the articles that ushered in the Miami boom, yuca was referred to as if it were some remote and terribly exotic substance known only to its adepts and only as yuca, a name that seemed to link it to the yucca plant, the entirely unrelated agave, or century plant, whose bloom is the state flower of New Mexico.

The snowbird epicures have begun printing the Miami chef's recipes without bothering to explain to readers that manioc/yuca is tricky to work with because it turns to glue in a food processor and sticks to your hands when you try to mold it into croquettes. Adding further to the confusion, the restaurant Yuca makes a little joke about its name. The owners like to tell people it means "young urban Cuban Americans." This has worked its way into

Yuca Con Mojo

(As served at Yuca Restaurant, Coral Gables, Florida)

- 2 pounds manioc (sold as yuca in Hispanic markets), peeled and cut into 1¼-inch pieces
- 1 small onion, peeled and thinly sliced
- ¼ cup olive oil
- 8 cloves garlic, peeled and minced
- Juice of 8 bitter oranges (sold in Hispanic markets as naranjas agrias), about 2 cups, or substitute 1 cup orange juice plus ½ cup each of lime and lemon juice
- 1 tablespoon chopped parsley leaves
- 1 tablespoon chopped fresh oregano leaves
- Salt and pepper

1. Cover manioc pieces in cold water to cover. Bring to a boil, reduce heat, and simmer until tender, about 20 minutes.
2. Meanwhile, heat olive oil in a skillet. Add onion and sauté until translucent. Add garlic, juice(s), herbs, salt, and pepper. Set aside.
3. Drain manioc and return to pot. Stir in onion mixture and cook with manioc over low heat for 12 minutes. Serve with pork chops or pork roast.

Yield: 6 servings

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print as "young upwardly mobile Cuban Americans," which might sound insultingly like yuppie to the well-fixed Miami Cubans who obviously do know what yuca means and get all the allusions to the traditional Cuban food that the ingenious innovations of Yuca's chef, Douglas Rodriguez, rest on.

Even without having had much experience with the cuisine it plays off, outsiders do, nevertheless, enjoy Yuca's food, because it is not a feat of prestidigitation effected with tropical American ingredients. I believe that what makes the menu successful for naïve as well as sophisticated palates is its basic cultural integrity—not the addition of caviar to pancakes based on a purée of the taro called *malanga*.

Yuca's ownership is partly Cuban, and many of the dishes are actually classic Cuban dishes, from the black bean soup to the mixed meat and tuber stew *ajiaco*. Another traditional offering is plantain stuffed with *tasajo*, "beef jerky."

This air-dried meat is a pre-Columbian delicacy still popular throughout Latin America. It is a far cry from the leathery stuff sold in Anglo convenience stores in thin strips for a snack, nor does it much resemble its mainstream U.S. cousin, chipped beef. Before going to lunch at Yuca, I bought a thick chunk of Uruguayan *tasajo* at a Cuban market-delicatessen-juice bar called El Palacio de los Jugos, "the juice palace." And then, during my second breakfast at Los Tios, I unwittingly prepared for the Yuca plantain/*tasajo* appetizer by eating a purée of *boniato* studded with chunks of *tasajo*.

Eating in Los Tios is a far cry from the young/urban/Cuban experience of lunch at Yuca. The diners at Los Tios speak Spanish and they stand up—there are no seats, except in the laundromat. So the faithful gather in a crowded little area in front of the counter/kitchen, and if they are like me, they listen hard in order to make out the conversation around them.

As I stood there masticating my *boniato relleno de tasajo*, a cab pulled up and the driver came in, looked at the starchy white spheres on the counter, clearly labeled as *fufu*, and asked: "What is that?"

"Yuca."

"I'm a Puerto Rican. We do something like that with plantain and pork, *mofongo*. I had to come here from New York to see this."

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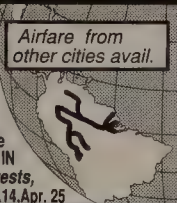
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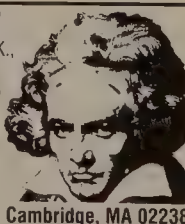
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Rican was learning about a separate strand of Latino-Caribbean cooking in Miami. From my perspective, the difference between *fufu* and *mofongo* is small. Both are survivals of slave adaptations of traditional West African yam dishes to Caribbean conditions. Even today *fufu* is a commonplace of West African diet. The word is African and so is *mofongo*. But neither the manioc nor the plantain base of these very similar dishes would have been available before 1500 in Africa.

Adding meat to tuber starch was and is, however, the basic West African meal, just as rice plus some nonstarch food is the basic Chinese food. But the similarity between *fufu* and *mofongo* is much less interesting to the adept than their difference. I suspect (and Africanists should know if I am right) that the two words come out of different African languages and cultures, but the important thing is that the dishes developed into sharply defined entities on two large Caribbean islands in regular contact since the early sixteenth century.

In contemporary West Africa, *fufu* is the generic term for a mashed tuber; it has been extended to include not only yams but also the other tubers brought in long ago from this hemisphere. But over here, a starchy ball of fried and pounded half-ripe plantain studded with pork cracklings is *mofongo*, and it is the property of Puerto Ricans and Dominicans. *Fufu* (or foo-foo) is a more widespread and general appellation that, in practice, has a more glutinous texture. This comes naturally with boiled manioc. It can also be achieved with boiled green plantain (plantains are not tubers, but what might be called tuber surrogates).

I did not attempt to explain this to the New York Puerto Rican driver. Instead, I bit into a ball of yuca *fufu* and tried to imagine myself in the driver's gustatory universe. It was a very different dish from the *mofongo* that I had eaten in Puerto Rico and, as I was to discover at Yuca, not at all like *boniato* stuffed with jerky. Clearly, all these tuber-plus-meat dishes had a family resemblance, but once you began to consider them seriously, they were as different as, say, *omelette aux fines herbes* is from a Denver sandwich or a *frittata*.

That I should see this was far less interesting than that the cabbie saw it, in a more powerful way than I ever could. There he was, a young urban Puerto Rican American, a yuppa, getting a broader sense of his Caribbean roots, in Miami, where he could earn a living wage driving confused Anglo foodies from their hotels to an elegant meal at Yuca. □

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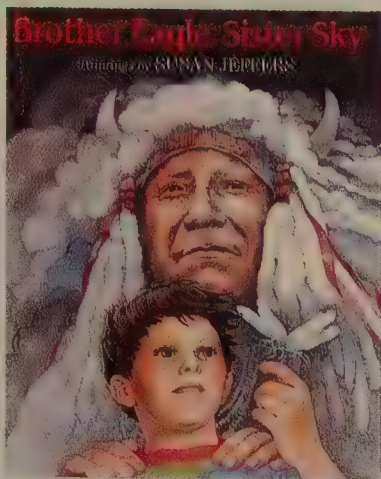
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CHIEFLY FEASTS The Enduring Kwakiutl Potlatch

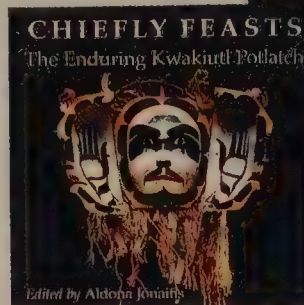
Edited by ALDONA JONAITIS

The Kwakiutl potlatch is a complex ceremonial during which the host family communicates its status by displaying inherited privileges embodied in lavishly decorated artworks and dances as well as by making elegant speeches detailing those privileges. The guests are treated to sumptuous cuisine and receive gifts as payment for having witnessed these displays.

The American Museum's Aldona Jonaitis is one of the world's foremost authorities on Northwest Coast Indian art. Includes color photographs of more than 100 artifacts from the Museum's collection plus over 80

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List \$60.00 MBP \$54.00



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13	14	15	16	17	18
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July

CHIEFLY FEASTS 1992 Wall Calendar

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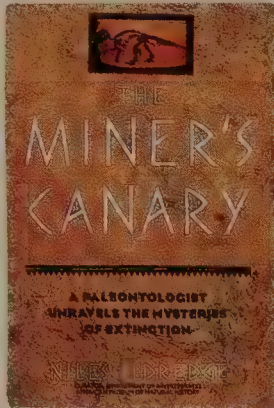
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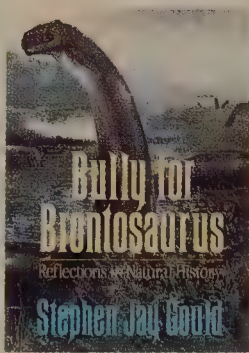
THE MINER'S CANARY A Paleontologist Unravels the Mysteries of Extinction

NILES ELDREDGE

The extinction of species is a fact of life for paleontologists, but even scientists as knowledgeable and



respected as American Museum Curator Niles Eldredge become concerned when the songbirds that should populate our backyards diminish noticeably in a few short years. In **THE MINER'S CANARY**—named for the birds that once alerted coal miners to odorless, poisonous gases—Eldredge brings his considerable expertise to bear on the search for a general theory of extinction: What causes it? 5½" x 8⅞", 256 pages #220
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STEPHEN JAY GOULD

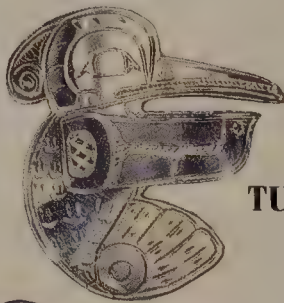
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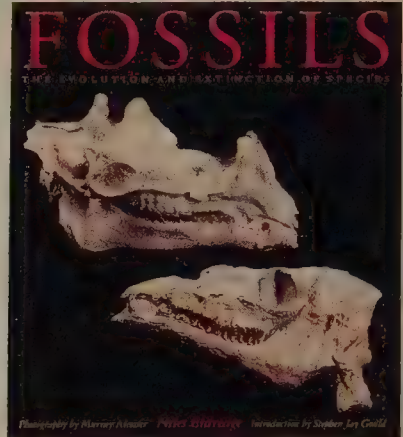


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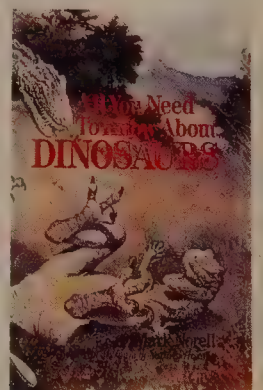
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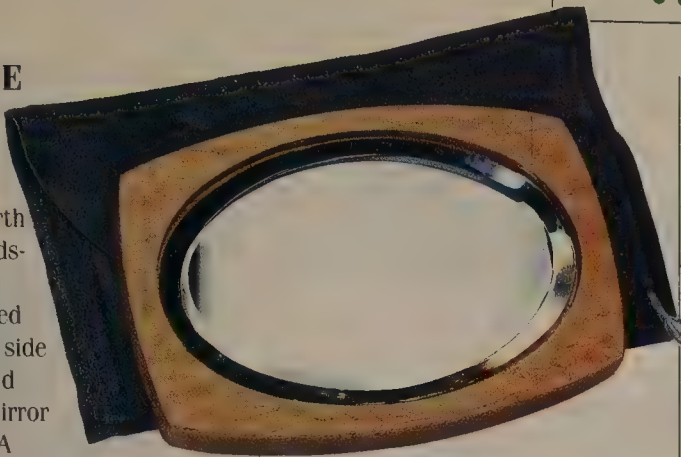
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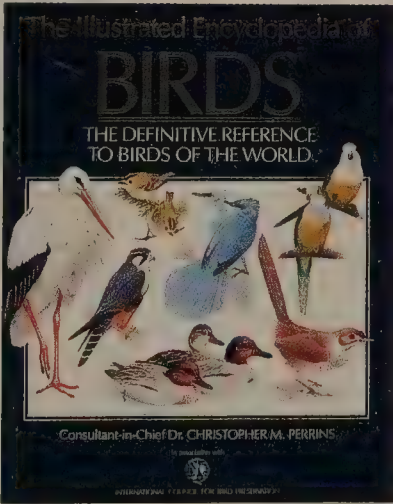
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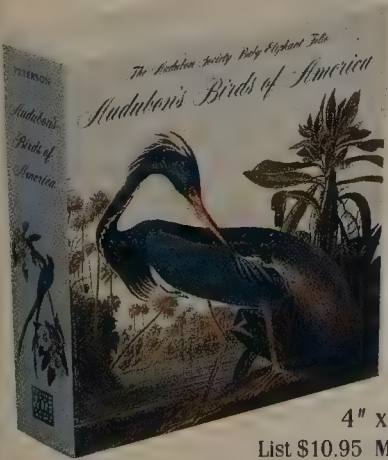
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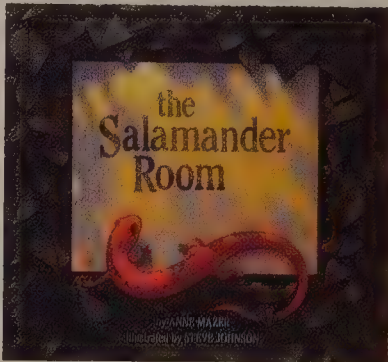


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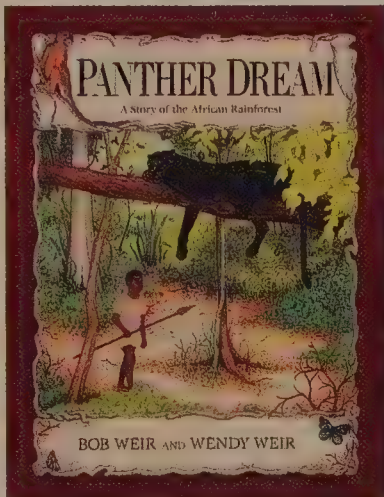
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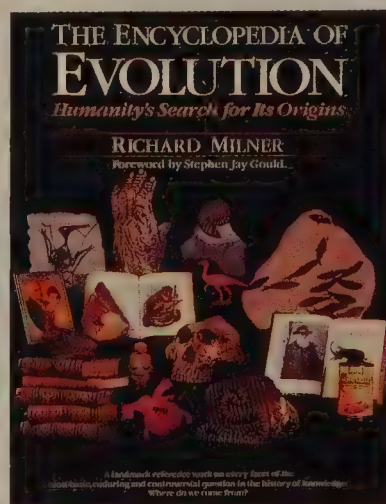
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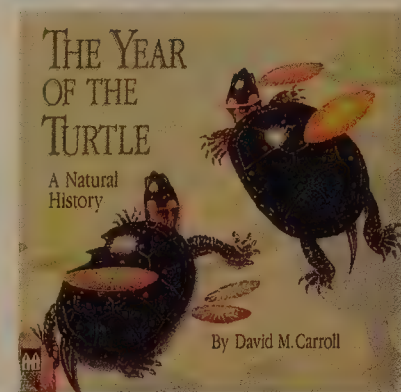
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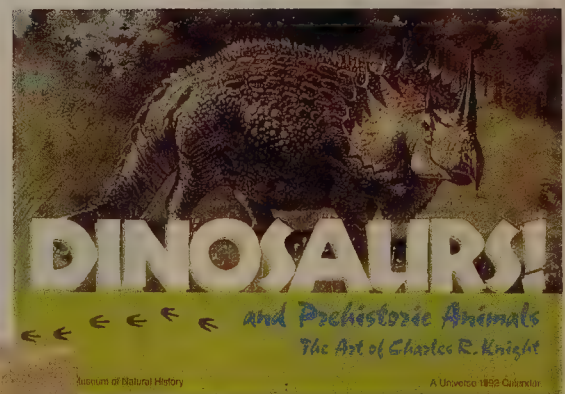
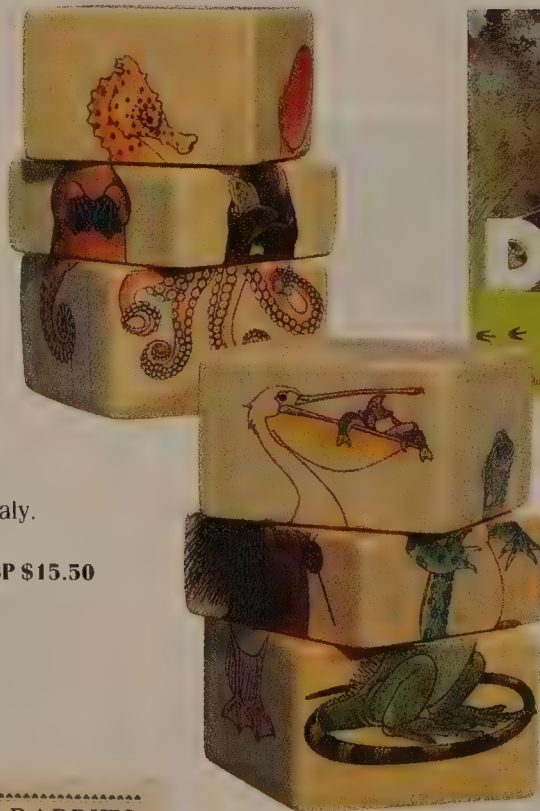
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Sailing Through a Comet's Path

by Gail S. Cleere

In the wee hours of October 20 to 22, little celestial diamonds will fly through the night sky, reminding us of the famous comet that visited us in the winter of 1985–86. In the hours after midnight on both nights, the earth will glide headlong into the orbital path of Halley's comet and will encounter small pieces of the comet's nucleus, treating us to a show of anywhere from ten to seventy "falling stars" per hour. This is the Orionid meteor shower, named for the constellation Orion—the place in the sky where the shower appears to emanate.

Meteors, or falling stars, can have many origins, but meteor showers are often bits of comets left behind in the elliptical orbit a comet makes around the sun. When the earth, in its own orbit around the sun, encounters this path, these small grains burn up in our atmosphere or, if they are large enough, fall to the ground, where they can be found as meteorites.

First recorded by the Chinese in A.D. 585, the Orionid meteor shower will peak two hours before midnight on the 21st for those in the eastern time zone. The best time to observe the shower from any location, however, is just after local midnight, when your location on earth is heading directly into the meteor swarm. The moon is up for most of the night and may obscure some of the show, but the performance by some of the debris from Halley's comet deserves our attention.

HALLOWEEN

In the last days of October, the earth reaches a place in its orbit around the sun that is nearly midway between autumnal equinox and the winter solstice. Because they neatly sliced the year into four manageable quarters, ancient Europeans called the equinoxes and solstices the quarter days. Those four days that fell between these dates they called the cross-quarter days.

The sun in the last days of October can be seen rising approximately halfway down along the southeastern horizon toward the place at which it will rise at the

dead of winter, reaching the cross-quarter day known to the Celts as Samhain. This was believed to be not only the start of winter but also a day of particular significance—a crack in time. The ancient feast of the dead was held, when the deceased could revisit the living and all sorts of supernatural spirits were thought to roam about. The strange and peculiar customs that we follow on Halloween are rooted in the observance of this astronomical landmark, which is thousands of years old.

The Christian church, however, came along during the Middle Ages and made a few changes. Samhain became All Souls' or All Saints Day, and the eve before the latter, being a former pagan feast day, was regarded as particularly unlucky and bedeviled. The old customs and beliefs persisted; witches and tabby cats flew about on broomsticks, fairies swarmed forth, fires were lit to ward off evil spirits, and mummers begged from door to door for money and sweet cakes in exchange for prayers for the dead. Of course, we have all but forgotten the astronomy.

THE PLANETS IN OCTOBER

Mercury slips behind the sun (as seen from our perspective on Earth) on the 3d, reaching superior conjunction and passing from the morning to the evening sky. It will not be seen again until November.

Venus is magnificent, as usual, as October's morning star, passing just below the constellation Leo. Look for Venus' brilliance some 3½ hours before sunup on your eastern horizon. On the 4th a handsome sliver of a moon passes close by the planet; on the 7th Venus passes under the star Regulus; and by the 16th, it is joined by fellow planet Jupiter.

Mars remains too close to the sun for us to observe in October.

Jupiter performs a lovely celestial dance with Venus (the brighter of the two) in predawn October skies. Both are seen not far from the kingly star Regulus in Leo. On the 4th and 5th, the crescent moon joins them all.

Saturn can be seen due south, about

thirty degrees above the horizon about an hour after sundown. This golden-colored planet is easily visible just east (left) of the teapot-shaped constellation Sagittarius. Watch this ringed beauty glide across the skies all evening, setting in the southwest about midnight.

Uranus and **Neptune** reside near each other and are never seen very far apart this year. They remain buried among the stars of Sagittarius. On the 14th, the moon pays them a visit.

Pluto rises and sets with the sun this month, on the borders of the constellations Libra and Serpens, where it has been for quite some time.

The **moon** is full on the 23d and is called the hunter's moon by the Algonquin Indians, the moon of the changing seasons by the Sioux, and the moon when the water freezes by the Cheyenne. New moon occurs on the 7th, first quarter on the 15th, and last quarter on the 30th. On the morning of the 4th, the thin, waning crescent moon is in Leo, where the bright star Regulus will be flanked by brilliant Venus on its right and Jupiter on its left.

P.S. October 27th is the last Sunday in the month, so those observing daylight saving time should set their clocks back an hour at 2:00 A.M. In 1784, Benjamin Franklin was the first to recommend the practice of adjusting the clocks during the summer to make the most of daylight hours. The idea did not catch on until World War I, however, when the government finally adopted daylight saving time (DST) in order to conserve fuel and aid in the war effort. DST was dropped in 1919 and then reinstated during World War II. In 1966, the Uniform Time Act was passed to minimize the local variations in the use of daylight saving time that persisted after World War II.

Gail S. Cleere writes on popular astronomy and is a founding member of the International Dark Sky Association, an organization dedicated to preserving the skies for astronomy.

Rosemary's Budworm

Highly magnified by an electron microscope, this creature, resembling a mutant pumpkin parasite or a hideous alien breaking out of its pod, is in reality a tobacco budworm emerging from its egg. Budworm moths lay their eggs, which are only one-sixteenth of an inch in diameter, on food plants that are most congenial to the larvae.

Unmagnified, the caterpillars look harmless enough, but to southern farmers growing tobacco, cotton, or soybeans, they remain a terror. After gnawing a hole in the egg, the budworm emerges, dines briefly on the remaining shell, then crawls

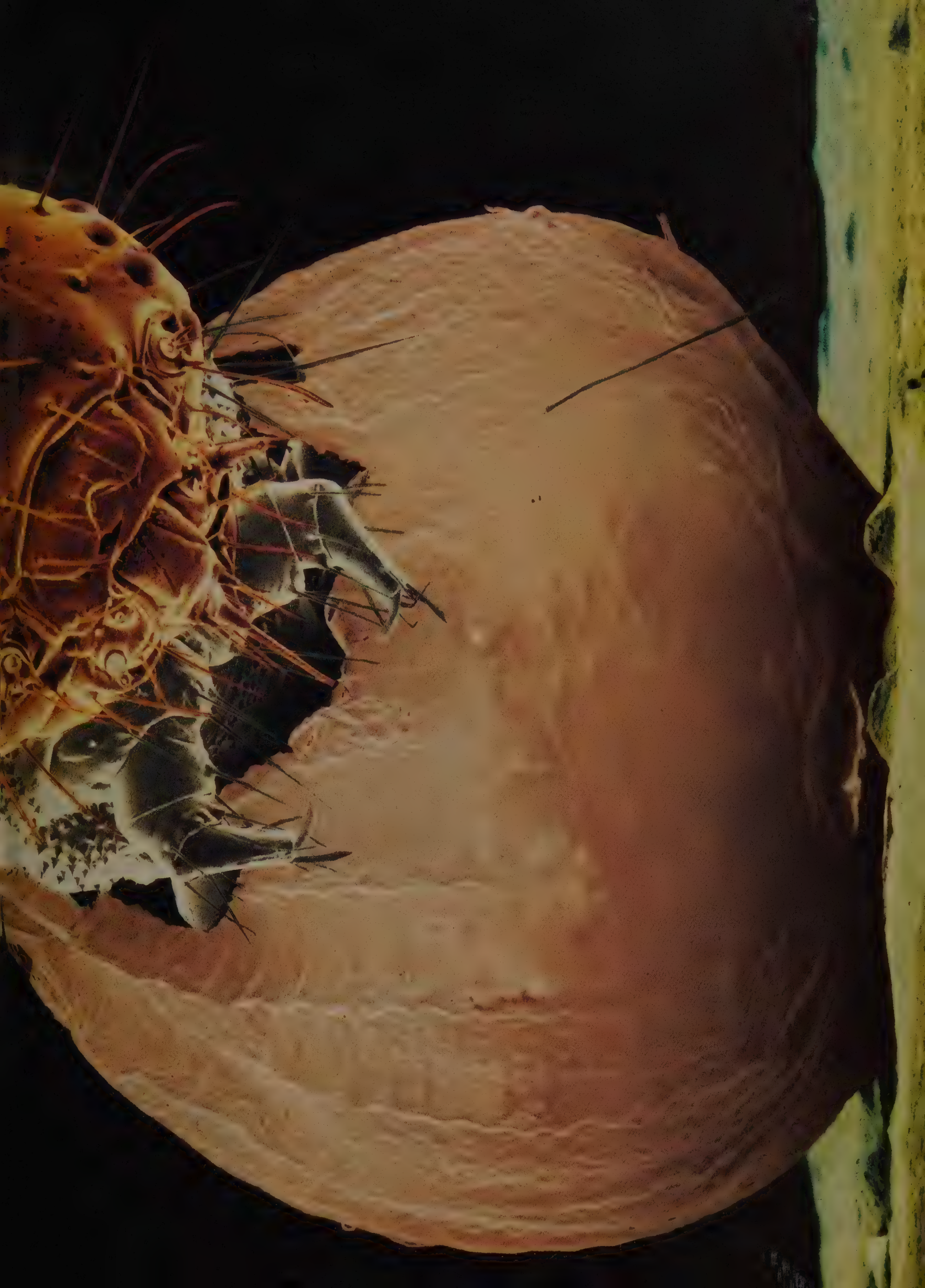
off, taking a few bites from tender young plant leaves before finally settling down to devour flower and leaf buds. Five eyes on each side of its head serve only as crude light sensors; the caterpillar relies more on chemical cues and a cover of sensory hairs to find its way around.

The adult female budworm, a light green moth, can distribute as many as 500 eggs, usually 2 or 3 per plant. The resultant larval army ruins cotton bolls early in their development and tears holes in young tobacco and soybean leaves. The insect is hardest to control in cotton because the larvae

burrow into buds, where they are protected as they feed. Insecticides are of little use, unless the budworm is exposed immediately after hatching, and even then, the larva is extremely resistant to the battery of poisons used against it. The budworm and another caterpillar, the cotton bollworm, have therefore become the major cotton pests, surpassing the boll weevil in their destructiveness. —R. A.

Photograph by David Scharf





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AUTHORS

Tim Clutton-Brock (page 34) has had a longstanding interest in the evolution of mammalian mating systems and has done field studies in Tanzania, Kenya, Uganda, Zambia, Brazil, and Scotland. He first became interested in the fallow deer of his native England in 1984, when he learned that a herd at the Petworth Park estate mated on a lek. Since then, he and his field team have spent five seasons there observing and analyzing the deer's social behavior. Clutton-Brock, who has earned two doctorates from the University of Cambridge, joined its Department of Zoology in 1981, where he is a reader in animal ecology and also runs the Large Animal Research Group. Among his current projects are studies



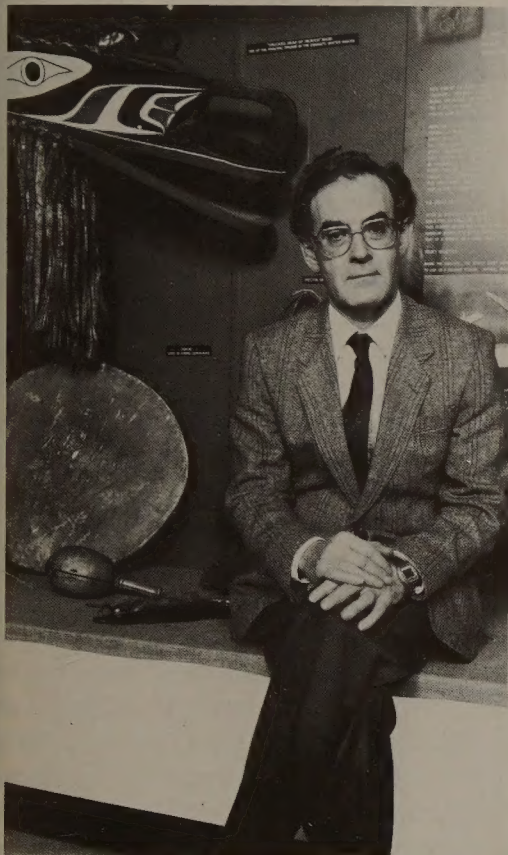
of isolated populations of ungulates on Scottish islands: Soay sheep on Saint Kilda and red deer on Rhum. Recently, Clutton-Brock was honored by the American Journal of Mammalogy for outstanding contributions to his field. His hobbies, he writes, with tongue in cheek, are "watching tropical fish and catching temperate ones," as well as "parental care in theory and practice." For further reading on leks he recommends "Leks and Mate Choice," by J. W. Bradbury and R. Gibson, in *Mate Choice*, edited by P. Bateson (New York: Cambridge University Press, 1983); and "Mate Choice on Leks," by A. P. Balmford (*Trends in Evolution and Ecology*, vol. 6, pp. 87-92).



Vice-president for Public Programs at the American Museum, **Aldona Jonaitis** (page 42) is the curator of the Museum's current exhibition on the Kwakiutl potlatch. A specialist in Northwest Coast Indian art, she wrote her doctoral dissertation on the art of the Tlingit and is currently working on a book about the whalers' washing shrine, a Nuuhah-nulth (Nootka) building in the Museum's collections. Coauthor **Peter Macnair**, an expert on Kwakiutl culture, is a curator at the Royal British Columbia Museum in Victoria. He served as special curatorial consultant to the Museum's potlatch exhibition. For additional reading, the authors recommend *Chiefly Feasts: The Enduring Kwakiutl Potlatch*, edited by Aldona Jonaitis (New York/Seattle: American Museum of Natural History and University of Washington Press, 1991), *From the Land of the Totem Poles: The Northwest Coast Indian Art Collection at the American Museum of Natural History*, by Aldona Jonaitis (New York/Seattle: American Museum of Natural History and University of Washington Press, 1988), and *The Legacy: Continuing Traditions of Canadian Northwest Coast Indian Art*, by Peter Macnair, Alan L. Hoover, and Kevin Neary (Victoria: British Columbia Provincial Museum, 1980).



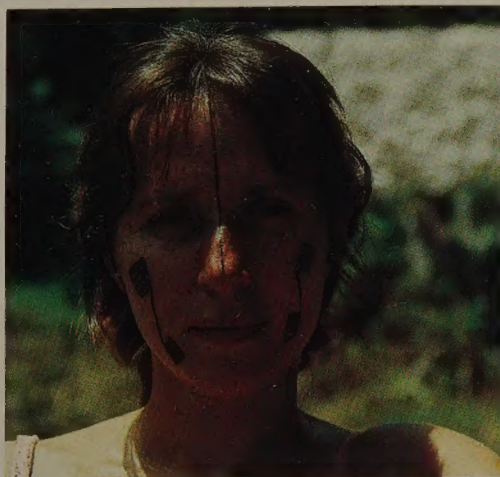
A professor of history at Simon Fraser University in British Columbia, **Douglas Cole** (page 50) became interested in the Kwakiutl potlatch while working on his book *Captured Heritage: The Scramble for Northwest Coast Artifacts*, a history of museum collections. Subsequently he coauthored, with Ira Chaikin, *An Iron Hand upon the People: The Law Against the Potlatch on the Northwest Coast*. (These books were published by the University of Washington Press, Seattle, in 1985 and 1990, respectively.)



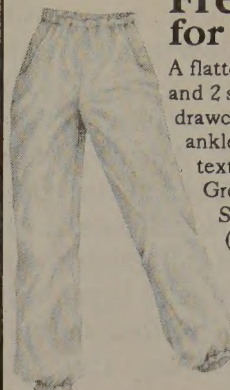
For additional reading, he recommends *To Make My Name Good: A Reexamination of the Southern Kwakiutl Potlatch*, by Phillip Drucker and Robert F. Heizer (Berkeley: University of California Press, 1967); *The Struggle for Survival: Indian Cultures and the Protestant Ethic in British Columbia*, by Forrest E. La Violette (Toronto: University of Toronto Press, 1973); and *Aboriginal Peoples and Politics: The Indian Land Question in British Columbia, 1849-1989*, by Paul Tennant (Vancouver: University of British Columbia Press, 1990).



During their last field trip to the Ituri rain forest in 1988-89, **David S. Wilkie** and **Gilda A. Morelli** (page 54) had the good fortune to participate (along with their graduate students Paula Ivey and Bryan Curran), in a coming of age celebration for several Efe and Lese girls. Part of the preparations for the ritual involved the making of elaborate bark cloths, which, along with body painting, is the main artistic medium of the Efe. David S. Wilkie is a socioecological consultant and adjunct professor in the Department of Psychology at Boston College; Gilda A. Morelli is an assistant professor of psychology at the same college. Both are part of the multidisciplinary study of the Efe that has been under way for the past ten years. Their graduate students Paula Ivey and Bryan Curran are both Ph.D. candidates in the Department of Anthropology at the University of New Mexico in Albuquerque. For more about the Pygmies of the Ituri rain forest, the authors recommend *People of the Tropical Rain Forest*, edited by J. S. Denslow and C. Padoch (Los Angeles: University of California Press, 1988).



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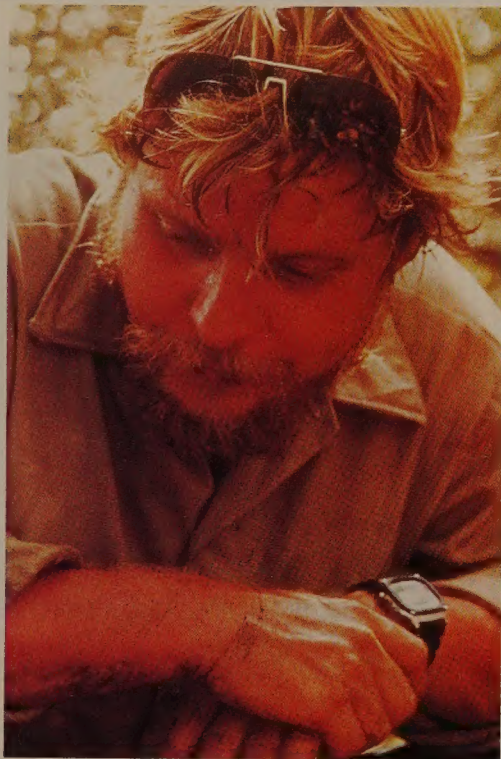


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Raymond Sokolov (pictured at his recent fiftieth birthday party with a friend) has been our witty and well-traveled food columnist since 1974. This month's "A Matter of Taste" (page 80) is his 200th column. A native Detroit who studied the classics at Harvard and Oxford, he found his calling as a writer and as an analyst of cultural foodways in the late sixties. Before he began writing for us, he had been the food and restaurant critic for the *New York Times* (1971-74) and had held various posi-



tions with *Time* and *Cue*. Sokolov's 1981 book, *Fading Feast*, based on his *Natural History* columns, spotlighted threatened and disappearing American foods. (Interest in these dishes revived shortly after. "I like to think I saved them," he says.) Now editor of the *Wall Street Journal's* Leisure and Arts section, Sokolov continues to travel and write. His latest book is *Why We Eat What We Eat: How the Discovery of the Americas Changed the Way Everyone on the Planet Eats* (Summit Books, 1991).

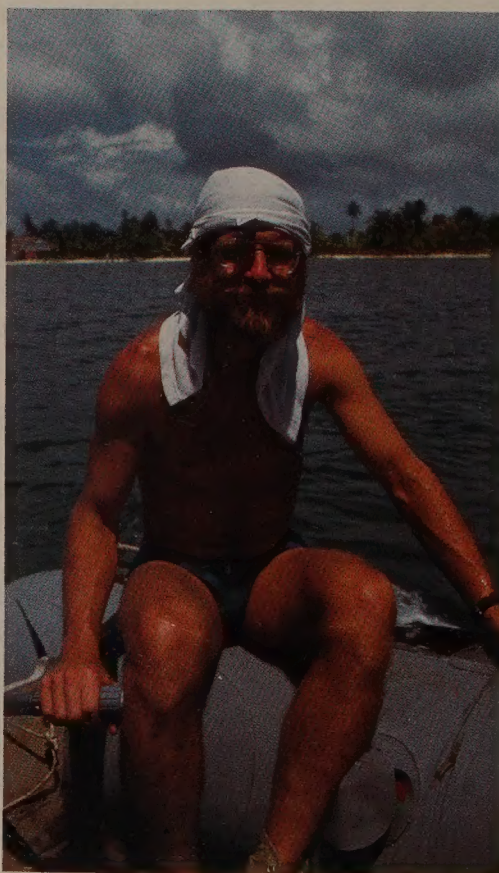


Having grown up in the Yucatán, frequenting coasts once plied by Maya traders, **Anthony P. Andrews** (page 72) began to focus in college on the history and coastal archeology of Maya seafaring. He is now professor of anthropology and chairman of the Division of Social Sciences at New College of the University of South Florida. For additional reading he recommends *Coastal Maya Trade*, edited by Heather McKillop and Paul Healey, Occasional Papers in Anthropology, no. 8 (Peterborough, Ontario: Trent University, 1989); "The Rise of a Maya Merchant Class," by Jeremy Sabloff and William Rathje (*Scientific American*, October 1975, pp. 72-82); and "Isla Cerritos: An Itzá Trading Port on the North Coast of Yucatan," by Anthony P. Andrews et al. (*National Geographic Research*, vol. 4, no. 2, Spring 1988, pp. 196-207).



After waiting patiently for two days and two nights, **David Scharf** (page 92) captured a tobacco budworm emerging from its egg—the subject of this month's "Natural Moment." Most images obtained with scanning electron microscopes (S.E.M.) require that the subject be dead and coated with an ultrathin layer of gold or carbon to "reflect" the electrons beamed at it. In the mid-1970s, however, Scharf pioneered a technique that allows live, untreated specimens to be imaged with the high-powered microscope. He enjoys exploring the very small, particularly insects. One such photographic project revealed the contents of dust balls—showing that they are mostly spider web and contain very few dust mites. He has also used his talents to make some of the first videos with the powerful microscopes, such as one at the Saint Louis Zoo that gives visitors a tour of the outside of the honeybee's body. Scharf currently runs his own photography and microscopy lab in Los Angeles and is working on a number of new S.E.M. techniques, including a system for "colorizing" the videos he shoots.

Ron Larson (page 66) first became interested in thimble jellyfish when he saw a few preserved specimens at the Smithsonian Institution. A student of the medusae for more than twenty years, he received his doctorate in marine biology in 1985 from the University of Victoria in Canada. In 1988, Larson took part in expeditions to the Arctic and Antarctic, where he studied both jellyfish and corals. He has also worked in the Atlantic, Caribbean, and North Pacific and has collected deep-sea medusae from submersibles at depths of up to 3,000 feet. Currently a wildlife biologist at the U. S. Fish and Wildlife Service in Brunswick, Georgia, Larson is completing a book on the natural history of Florida's swamps. For further reading on jellyfish and their kin, he recommends *Open Sea: Its Natural History*, by Alister Hardy (Boston: Houghton Mifflin Co., 1971), and *Animals Without Backbones*, by Ralph Buchsbaum (Chicago: University of Chicago Press, 1948).



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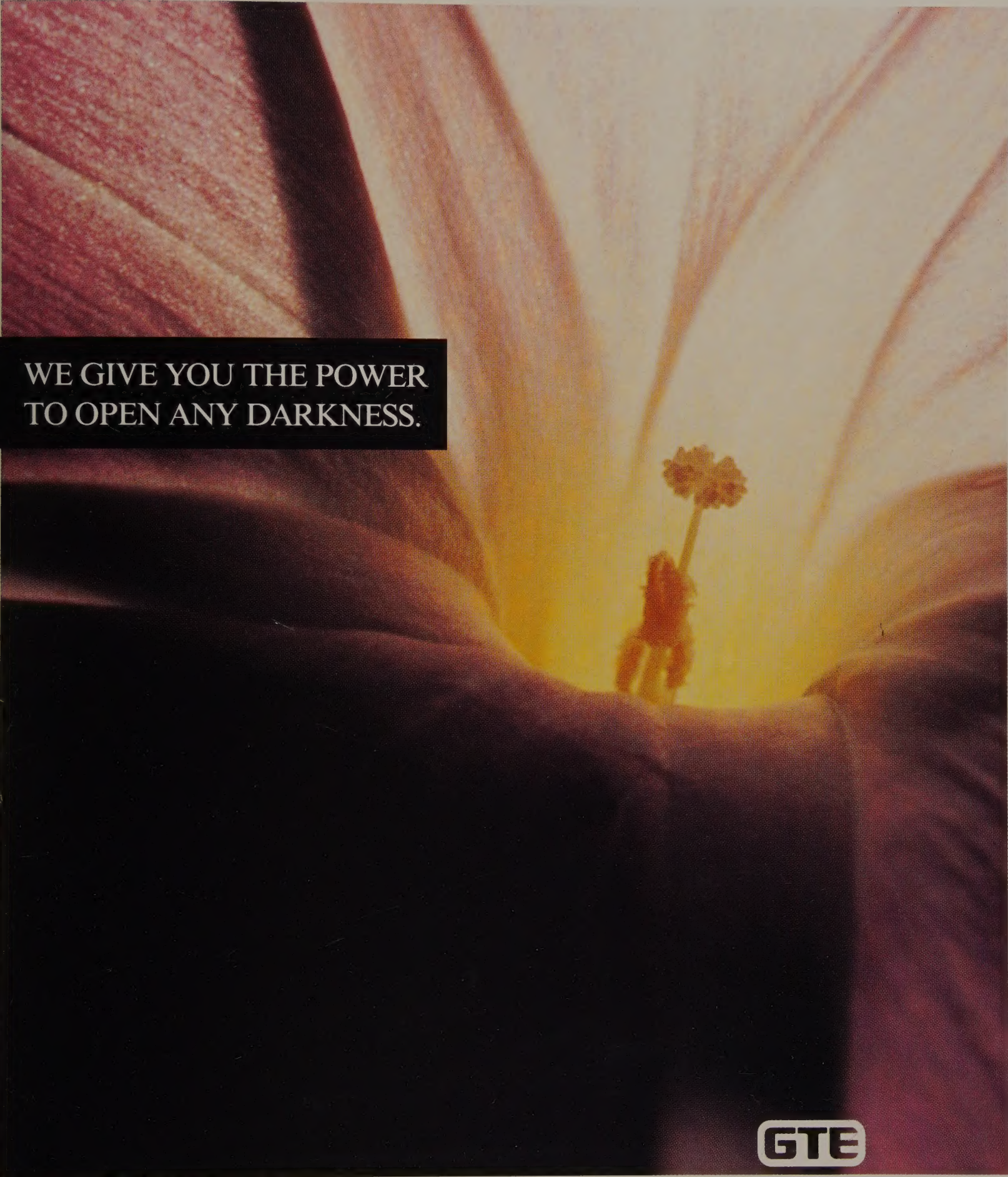
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